INDIAN AGRICULTURA[illegible]CH INSTITUTE

LIBRARY
New Delhi

Call No.
Acc. No. 314969

Author Index

Symbols following the authors' names are to be interpreted as follows: L—Letter to the Editor; Lab—In the Laboratory; O—Obituary; R—Book Review; T—Technical Paper.

A

Abbot, C. G., 407. L.
Abbott, Cyrll E., 318. L.
Ackerknecht, Erwin H., 344. L.
Adcock, John D., 355.
Addoms, Ruth M., et al., 371. L.
Adel, Arthur, 280. L.
Adsuar, José, 316. L.
Alden, Roland H., 120. R.
Alexander, Ben H., 636. R.
Alexander, Jerome, 147; 371, L.
llen, Lee, et al., 144. Lab.
lmquist, H. J., 722. T.
ltschul, Rudolf, 566. Lab.
lverson, Clara M., 398. Lab.
nderson, Dorothy Trotter, 454. Lab.
nderson, Hamilton H., et al., 419. T.
nderson, Russell H., 342. L.
ngier, Robert B., et al., 667. T.
ricti, S., 749. T.
senjo, Conrado F., 219. T.
smous, Vladimir C., 282. L; 761. L.
ydelotte, Frank, 215.
yre, J. Ernest, 441.

B

Badger, Richard M., 240. R.
Baier, W. E., et al., 280. L.
Baker, Kenneth F., 500. T.
Baker, Kenneth F., et al., 707. T.
Ball, Carleton R., 714. L.
Bard, Basil J. A., 6.
Barrett, E. P., 401. Lab.
Bartlett, James C., Jr., 681. T.
Bassett, Raymond E., 26. L.
Bateson, Gregory, 717.
Baudisch, O., 744. T.
Bauer, Raymond A., 89; 152, R.
Bauld, W. A. G., 441. T.
Beard, R. L., 372. L.
Beatty, Croom, III, 235. L.
Behre, Charles H., Jr., 418. O.
Beinhart, E. G., 208. L.
Bennett, R. D., 85. L.
Best, C. H., 207. L.
Best, C. H., et al., 12. T.
Beaman, I. I., 401. Lab.
Binger, Carl, 574. R.
Bird, H. R., 584. T.
Bishop, S. C., 175. L.
Blau, M., 744. T.
Block, R. J., 432. L.
Blum, Harold F., 634. L.
Bodecker, Charles F., 542. L.
Boisvert, Paul J., et al., 352.
Bollenback, Carol Houck, 445. T.
Bolling, D., 432. L.
Bondi, A., 676. R.
Bondi, Amedeo, Jr., et al., 399. Lab.
Bonnet, David D., 149. L.
Bowman, Isaiah, 319.
Braden, Spruille, 323.
Bradley, W. H., 178. L.
Brody, Matthew, 570. L.
Bronfenbrenner, J. J., 89. L.
Brooks, Charles F., 281. L.
Brown, Harold W., [illegible]. T.
Brown, Herbert C., [illegible]. T.
Buchanan, L. L., 7[illegible]. R.
Buell, Murray F., 14. T.
Buggs, C. W., et al., 363.
Burdon, Kenneth L., 738. R.
Burkenroad, Martin D., 684. T.
Burr, H. S., 48. T.

C

Cain, Stanley A., 129.
Caldwell, M. J., et al., 616. T.
Caldwell, Otis W., 507.
Caldwell, Otis W., et al., 245.
Camp, Charles L., 302. O.
Cantino, E. C., 75. Lab.
Carlson, A. J., 377; 738. R.
Carlson, Robert F., et al., 473. T.
Carter, George F., 344. L.
Carter, H. E., et al., 53. T.
Carter, H. E., et al., 540. L.
Cartwright, G. E., et al., 72. T.
Carvajal, Fernando, 112. Lab.
Chamberlain, Katherine, 158.
Chambers, Robert, 160; 287. R.; 726.
Chanis, Herbert, 545. R.
Chermock, Ralph L., 731. Lab.
Chilton, Martha, et al., 361.
Chin, Yin-ch'ang, 654. L.
Christian, John E., 172. Lab.
Church, James M., 348. R.
Clark, Walter S., 145. Lab.
Cockerell, T. D. A., 235; 281. L.
Coghill, Robert D., 738. R.
Coghill, Robert D., et al., 709. T.
Cohn, Alfred E., 431. L.
Colbert, Edwin H., 89. R.
Cole, W. Storrs, 30. R.
Coleman, C. D., 731. Lab.
Compton, Karl T., 191.
Condon, E. U., 415.
Cook, Samuel R., 27. L.
Cordell, R. J., 370. L.
Couch, James F., et al., 197. T.
Cowl[illegible] Raymond B., 74. T.
Craig, Lyman C., et al., 587. T.
Cross, J. Hollie, 634. L.
Cushing, Daniel, et al., 568. Lab.

D
I
I
I
Davis, Watson, 688.
Deakin, Alan, 572. L.
Deese, James, et al., 49. T.
Degering, Edward F., 152. R.
Dehner, Eugene, 171. Lab.
De Mont, Jack, 178; 632. L.
Dempster, J. R., 488. L.
Denny, Wayne B., 32. R.
Deonier, Christian C., 13. T.
De Robertis, Eduardo, 421. T.
De Terra, H., 344. L.
Deuel, Harry J., Jr., 183.
Dewar, Robert Kerr, 488. L.
Dibblee, Diana, 734. L.
Dice, Lee R., 403. L.
Diehl, William W., 283. L.
Dietz, Catherine C., et al., 399. Lab.
Donovick, Richard, 330. T.
Dove, W. Franklin, 187.
Drill, Victor A., 199. T.
DuBois, Adrien S., 734. L.
Duff, Fratis L., 223. T.
Dunham, Wolcott B., 365.
Dunn, L. C., 181. R.
Duran-Reynals, F., 748. T.
Duval, Addison M., 348. R.

E

Eagle, Harry, 618. T.
Eberhardt, W. H., 429. Lab.
Eisendrath, David B., 418. O.
Eisman, P. C., et al., 674. L.
Eisner, Hans, 629. Lab.
Eklund, Henning W., et al., 613. T.
Ellickson, Raymond T., 316. L.
Elvehjem, C. A., 210. R.
Ennis, W. B., et al., 476. T.
Erwin, A. T., 302. O.
Espoy, Henry M., 175. L.
Evans, Bergen, 713. L.
Ezell, Boyce D., 193. T.

F

Fankuchen, I., et al., 25. L.
Farnsworth, Dean, 545. R.
Feild, A. L., 636. R.
Fels, Samuel S., et al., 50. T.
Finland, Maxwell, et al., 501. T.
Fischer, E., 455. Lab.
Flanders, Stanley E., 555. T.
Flower, Rousseau H., 86. L.
Fogg, John M., Jr., 736. R.
Fosberg, F. Raymond, 283. L.
Foster, Laurence S., 656. R.
Fowle, C. David, 708. T.
Fox, Sidney W., 445. T.
Frank, Lawrence K., 349.
Franzen, Raymond, 462. R.
Freire de Guzmán, Ana Rosa, 219. T.
French, C. S., et al., 505. T.
Frings, Mable R. and Hubert, 22. Lab.
Fromm, F., 635. L.
Frondel, Clifford, 326. T.
Frost, Douglas V., et al., 362.
Fuller, Leonard F., 374. L.
Fulton, MacDonald, et al., 361.

G

Gamble, Clarence J., 458. L.
Gaposchkin, Sergei, 404. L.
Gerard, R. W., 4.
Gerber, Isadore E., 167. T.
Gerjovich, H. J., 202. Lab.
Germann, Frank E. E., 68.
Giese, Arthur C., 543. L.
Gill, Richard C., 147. L.
Gillin, John, 62. R.
Gilman, Alfred, 409; 436.
Glick, David, 699. L.
Goldsmith, E. D., 649.

314969
IARI

Gordon, Harry H., et al., 391. T.
Graham, Boyd E., et al., 364.
Gramet, Charles A., 149. L.
Granick, S., 107. T.
Gray, John S., 739.
Green, Robert G., 497. T.
Greenstein, Jesse P., 211. R.
Grenell, R. G., 48. T.
Gross, Milton, 167. T.
Grossberg, Donald B., et al., 615. T.
Groupé, Vincent, 330. T.
Grover, Frederick W., 490. R.
Gudger, E. W., 694. L.
Guerra, Francisco, 686. T.
Gurchot, Charles, 25. L.

H

Hall, Ivan C., 423. T.
Hammett, Frederick S., 714. L.
Hammett, Louis P., 285. R.
Hamner, C. L., et al., 473; 476. T.
Hansen, H. N., et al., 707. T.
Hardy, LeGrand H., 122. R.
Harkins, William Draper, 289.
Harnly, Morris Henry, 649. T.
Harrington, E. R., 488. L.
Harrison, George R., 125.
Hart, E. B., 434. L.
Hartman, Carl G., 493.
Hartnett, John C., 114. Lab.
Harwood, Paul D., 207. L.
Haseman, Leonard, 331. T.
Hastings, A. Baird, 605; 637.
Hatfield, E. D., 75. Lab.
Hawkinson, Violet E., et al., 338. Lab.
Hayes, H. K., 751. O.
Hazel, G. R., et al., 709. T.
Hecht, Selig, 462. R.
Hedgpeth, Joel W., 236. L; 436. R.
Hemming, Francis, 656. L.
Hemphill, Emmarie C., 422. T.
Henne, Albert L., 30. R.
Hershberger, W. D., 371. L; 376. R.
Hervey, George W., 734. L.
Hettig, Robert A., 355.
Heuser, G. F., et al., 303. T.
Heyman, Karl, 174. L.
Hickman, K., 406. L.
Hiestand, William A., 26. L.
Hildebrand, E. M., 465; 492; 477. T.
Hill, C. G. A., 155.
Hills, Claude H., 166. T.
Hodes, Horace L., et al., 357.
Hoebel, E. Adamson, 602. L.
Hoffmeister, J. Edward, 182. R.
Hogan, Joseph T., 332. O.
Holtman, D. Frank, 137. T.
Hoskins, R. G., 696. R.
Howe, Clifton D., 223. T.
Hughes, J. S., et al., 616. T.
Hulburt, Ray G., 118. L.

I

Ives, Willard G., 86. L.

J

Jang, C. S., et al., 59. L.
Jenkins, John G., 33.
Jensen, J. C., 733. L.
Jensen, James L., 586. T.
Jillson, Willard Rouse, 59. L.
Johnson, Howard C., et al., 108. T.
Johnson, Marvin J., et al., 504. T.
Jones, Edgar, et al., 108. T.
Jones, Howard A., 13. T.

K

Katz, Daniel, 612. O.
Keller, William F., 137. T.
Kellogg, W. N., et al., 49. T.
Kelly, Maurice J., 370. L.
Kent, John F., 598. L.
Keys, Ancel, et al., 669. T.
Kinard, F. W., 731. Lab.
King, Joseph E., 487. L.
Knopf, Eleanora Bliss, 99.
Koerper, E. C., 207. L.
Kofoid, Charles A., 182. R.
Koller, P. C., 86. L.
Kolthoff, I. M., 104.
Komarov, S. A., et al., 50. T.
Kornberg, Arthur, et al., 646. T.
Kosolapoff, G. M., 236. L.
Kraatz, Walter C., 599. L.
Kramer, Paul J., 543. L.
Krebs, E. T., Jr., 25; 460. L.
Krewson, Charles F., et al., 197. T.
Kuizenga, Marvin H., et al., 364.

L

Lamanna, Carl, et al., 613. T.
Lang, Walter B., 176. L.
Langham, D. G., 280. L.
Lankford, Charles E., et al., 361.
Leach, W. James, 341. Lab.
Leake, Chauncey D., 148. L.
LeClerc, Germaine, 553. T.
Lee, Robert C., 537. Lab.
Leighton, Henry, 695. L.
Leikind, Morris C., 435. R.
Leinfelder, P. J., et al., 144. Lab.
Levi, Herbert W., 175. L.
Levine, Philip, 389. T.
Levinson, N., et al., 284. L.
Libby, W. F., 240. R.
Lieker, Herbert, 694. L.
Lind, S. C., 762. L.
Little, C. C., 544. L.
Livingston, Burton E., et al., 245.
Lochman, Christina, 286. R.
Loeb, Leonard B., 541. L.
Long, J. A., 170. Lab.
Longenecker, Herbert E., 210. R.
Longwell, Chester R., 206. L.
Loomis, Ted A., 199. T.
Lubinski, Herbert H., 76. Lab.
Lucas, C. C., et al., 12. T.
Luckey, T. D., et al., 682. T.
Lukesh, Joseph S., 574. R.

M

McDermott, Walsh, et al., 359.
McElroy, Olive E., et al., 613. T.
McEwen, Robert S., 178. L.
Macht, David I., 402. L.
Mack, Arthur D., 21. Lab.
MacKay, Eaton M., et al., 673. L.
McLaren, A. D., 503. T.
McLaughlin, Dean B., 760. L.
Macleod, John, 73. T.
McMillan, Thelma J., 196. T.
MacNeal, Ward J., et al., 620. T.
Marks, Maurice E., 603. R.
Marsh, W. S., et al., 673. L.
Martin, G. W., 117. L.
Masserman, Jules H., 28. R.
Mayer, R. L., et al., 673. L.
Meads, Manson, et al., 501. T.
Medcof, J. C., 488. L.
Melnick, Daniel, et al., 326. T.
Melvin, Bruce L., 105; 241.
Menkin, Valy, 648. T.
Merritt, H. Houston, 238. R.
Meyerhoff, Howard A., 10; 70; 133; 161; 192; 270; 382; 479; 510; 589; 687; 725.
Meyers, Thomas J., 118. L.
Michaelis, M., 673. L.
Milas, Nicholas A., 581. T
Miller, Alden H., 32. R.
Miller, Carl D., 404. L.
Miller, Lawrence P., 458.
Miller, R. B., 762. L.
Miles, Walter R., 93. R.
Minnick, R. S., 749. T.
Montagu, M. F. Ashley, 284; 570. L.
Moog, Florence, 144. Lab.
Morrell, William E., 113. Lab.
Morse, Stanley F., 761. L.
Moulton, F. R., 250; 506.
Moulton, F. R., et al., 245.
Moulton, J. E., et al., 476. T.
Mullen, James A., 632. L.
Muller, H. J., 550. O.
Muller, Hugh E., 731. Lab.
Mullins, Lorin J., 635. L.
Musselman, Arlyne, 618.
Myers, Victor C., 376. R.

N

Naghski, Joseph, et al., 19 T.
Ness, Helen T., et al., 19 T.
Neuroth, Milton L., 172. L
Nickerson, Walter J., 4 Lab.; 635. L.
Nielsen, Jean K., et al., Lab.
Nissen, Henry W., 27. L.
Noble, Baxter G., 759. La
Norris, L. C., et al., 303.
Nowinski, Wiktor W., 4 T.
Noyes, C. Reinold, 404.

O

O'Brien, Harold C., Jr., 4 Lab.
Offord, H. R., 474. T.
Oliver, C. P., 88. R.
Olmsted, J. M. D., 384.
Olson, P. J., 656. L.
Orent-Keiles, Elsa, et a 498. T.
Ory, Edwin M., et al., 501.
Oser, Bernard L., et al., 82 T.
Oster, Gerald, 306. T.

Osterberg, A. E., et al., 709. T.
Ostro, Marcus, 402. L.
Owen, G. Edgar, 570. L.

P

Pannell, James H., 177. L.
Parsons, Helen T., et al., 198. T.
Rathman, Julian H., 22. Lab.
Patterson, J. M., et al., 12. T.
Pauli, Wolfgang, 213.
Pauling, Linus, et al., 338. Lab.
Pauls, Frances, et al., 673. L.
Peck, John L., et al., 357.
Penfound, William T., 487. L.
Pennington, Derrol, 397. Lab.
Perlin, A. S., 673. L.
Peterson, D. R., 55. Lab.
Philips, Frederick S., 409; 436.
Pierce, W. Dwight, 545. R.
Pijoan, M., 202. Lab.
Pillemer, Louis, et al., 615. T.
Platt, John R., 347. R.
Pollard, Arthur L., 758. Lab.
Ponder, Eric, 73; 331. T.
Porzecanski, Bernardo, 629. Lab.
Prado, J. Leal, 406. L.
Pratt, Robertson, 535. Lab.
Price, Clifford W., et al., 56. Lab.
Price, Echo L., et al., 198. T.
Prien, Edwin L., 326. T.
Prince, Ralph N., et al., 568. Lab.
Pronko, N. H., et al., 49. T.

R

Raab, Walter, 670. T.
Rake, Geoffrey, 365.
Raleigh, G. J., 207. L.
Rantz, Lowell A., et al., 352.
Raper, Kenneth B., 735. L.
Ratcliffe, A. W., 630. Lab.
Ray, Cyrus N., 118. L.
Reeder, Ruth, 201. Lab.
Reid, Roger D., 454. Lab.
Reid, W. Malcolm, 206. L.
Rein, Charles R., 598. L.
Renn, Charles E., 715. R.
Richards, A. N., 174. L; 575.
Ridout, J. H., et al., 12. T.
Riess, Bernard F., 27. L.
Riordan, John T., 499. T.
Rising, L. Wait, 676. R.
Risser, William C., et al., 362.
Robbie, W., et al., 144. Lab.
Roeder, Kenneth D., 304. T.
Rogers, Lockhart B., 420. T.
Rollefson, G. K., 763. R.
Ruben, J. A., 220. T; 634. L.
Rubin, Max, 584. T.

S

Sá-Fleitas, M. José, 499. T.
Sampey, John R., 734. L.
Sargent, Frederick, II, 317. L.
Scates, Douglas E., 657.
Scharrer, Ernst, 578.
Schaubhut, Ralph G., 370. L.
Schenck, Jay R., et al., 362.
Schmitt, Francis O., 143. O.
Schneider, M., et al., 25. L.
Schueler, F. W., 221. T.
Schuhardt, V. T., 422. T.
Schwartz, Samuel, et al., 338. Lab.
Scott, M. L., et al., 303. T.
Scudi, John V., 567. Lab.
Seager, Lloyd D., 353.
Sebrell, W. H., et al., 646. T.
Seiberlich, Joseph, et al., 568. Lab.
Seifter, Joseph, et al., 762. L.
Sellards, E. H., 632. L.
Shay, Harry, et al., 50. T.
Sheng, T. S., 346. L.
Shepard, Ward, 65.
Shimkin, Michael B., 605; 637.
Shneiderov, Anatol J., 487; 675. L.
Shull, George Harrison, 547.
Silverman, Leslie, 537. Lab.
Simha, Robert, 716. R.
Sinason, H., 744. T.
Singer, J. et al., 25. L.
Siplet, H., et al., 50. T.
Skelton, Floyd, et al., 762. L.
Smith, Arthur Bessey, 634. L.
Smith, Clifton A. H., 634. L.
Smith, E. Lester, 281. L.
Smith, F. G. Walton, 609.
Smith, Frederick G., et al., 473. T.
Smith, Grace H., 599. L.
Smith, Grace H., et al., 59. L.
Smith, H. H., et al., 476. T.
Smith, Homer W., 724.
Smith, James G., 492. R.
Snyder, William C., 500. T.
Snyder, William C., et al., 707. T.
Spaulding, Earle H., et al., 399. Lab.
Speiser, Rudolph, 166. T.
Spencer, G. J., 456. Lab.
Spink, Wesley W., et al., 352.
Stanley, John, 115. Lab.
Stansly, Philip G., 398. Lab.; 403. L.
Stein, I. Melville, 239. R.
Steinbach, H. Burr, 144. Lab.
Steinberg, Robert A., 329. T.
Stevens, S. S., 677.
Steyaert, R. L., 695. L.
Stice, Edith, 535. Lab.
Stock, Chester, 470. O.
Strickland, J. C., 112. Lab.
Strong, Leonell C., 554. T.
Struve, Otto, 342. L.
Stuhlman, Otto, Jr., 374. R.
Stulberg, Cyril S., 497. T.
Sturdivant, J. H., et al., 338. Lab.
Sverdrup, H. U., 90. R.
Sydenstricker, V. P., et al., 194. T.
Syz, Hans, 628. Lab.

T

Taft, Charles H., 340. Lab.
Tainter, M. L., 95.
T'ant, Chi-hsueh, 654. L.
Teare, B. R., 574. R.
Terman, Lewis M., 60. R.
Terrill, Clair E., 407. R.
Thom, Charles, 735. L.
Thomas, Lewis, et al., 357.
Thomas, Lyell J., 21. Lab.; 59. L.
Thompson, H. E., et al., 476. T.
Tipson, R. Stuart, 634. L.
Todhunter, E. Neige, 196. T.
Tolpin, J. G., 86; 402. L.
Torda, Clara, 645. T.
Treffers, Henry P., 387. T.
Trumpler, R. J., 122. R.
Trytten, M. H., 437.
Tukey, H. B., et al., 476. T.

U

Urdang, George, 25. L.

V

Valentine, W. L., 1.
Vander Brook, Milton J., et al., 364.
Van Overbeek, J., 472. T.
Velasco, F., 455. Lab.
Vélez, Ismael, 472. T.
Venable, Wm. Mayo, 600. L.
Verdoorn, Frans, 373. L.
Ver Steeg, Karl, 541. L.
Visscher, Maurice B., 104.
Vivell, A. E., 696. R.

W

Wachtel, Henry K., 556. T.
Wadley, F. M., 408. L.
Walker, A. Earl, et al., 116. L.
Walker, Egbert H., 764. R.
Wallace, Henry A., 724.
Waller, R. K., 389. T.
Wallerstein, Harry, 583. T.
Ward, Harold, 177. L.
Ward, Roswell, 459. L.
Warden, C. J., 749. T.
Warner, Rosemary, 720. T.
Watson, C. J., et al., 338. Lab.
Watson, E. M., 654. L.
Weiant, Elizabeth A., 304. T.
Weiss, Sidney, et al., 326. T.
Welch, Henry, et al., 56. Lab.
Welch, M. W., 430. L.
Wells, B. W., 284. L.
Wenrich, D. H., 551. O.
Werkman, C. H., 463. R.
Weyl, Hermann, 216.
Wheeler, Carl O. J., 751. O.
Wheeler, Homer Jay, 751.
Wherry, Edgar T., 206. L.
Whiting, Anna R., 219. T.
Whitney, Leon F., 655. L.
Wichterman, Ralph, 23. Lab.
Wick, Arne N., et al., 673. L.
Wiener, A. S., 147; 570. L.
Wiggins, Ira L., 459. L.
Wilcox, Marguerite S., 193. T.
Williams, Carroll M., 57. Lab.
Williams, H. L., 654. L.
Williams, Roger W., 224. T.
Willis, Senator Raymond E., 163.
Winnek, Philip S., 719. T.
Wise, G. H., et al., 616. T.
Witschi, Emil, 603. R.
Wittler, Ruth, et al., 615. T.
Wittwer, S. H., 331. T.
Wolff, Harold C., 645. T.
Wolfrom, M. L., 408. L.
Wood, Reuben E., et al., 338. Lab.
Wood, Scott E., 716. R.

Y

Yardumian, K., 220. T.
Yarwood, C. E., 87. R.
Young, Leslie, 489.

Subject Index

A

- A, Vitamin. (See Vitamin A.)
- AAAS. (See Association Affairs.)
- Absorption of Phenol Vapors by Plants, 207
- Acanthocephalan, Cestode "Parasitized," 762
- Acetylcholine Synthesis, 645
- Acheson Report (International Control of Atomic Energy), 451
- *Actualités Medico-chirurgicales* (Scientific Pamphlets), 634
- Adenosinetriphosphatase, Histochemical Localization, 144; 599
- Aerator, Tap-water, 75
- Agar Cup-plates, Sterile Technic for Preparing, 172
- Agglutination, Iso- and Hetero-, with Cord Sera, Prozones and Blocking Effect, 76
- Agricultural Science Program, Yale University, 623
- Aircraft for Oceanographic Surveys, 635
- Albion College, Biological Preserve, 336
- Albuquerque High School, Science Courses, 487
- *Alcaligenes fecalis*, Effect of Penicillin, 361
- Algae in Carlsbad Caverns, 175
  - Culture Method for Marine, 112
- Alkyl Sulfates, Gastric Mucigogue Action, 50
- Alloxan, Diabetes by Feeding to Cats, 220
  - "Purple" Test, 634
- Amebiasis, Serodiagnosis, 598
- American Institute of Biology, Proposal, 692
  - *Journal of Botany*, Editor-in-chief, Bernard S. Meyer, 448
  - Mathematical Society and Mathematical Association of America on Universal Military Service, 579
  - Universities, Study of Scientific Russian, 86
- Americium, Proposed Name for Element 95, 481
- Amines and Sulfides, B-Chloroethyl, Biological Actions and Therapeutic Applications, 409, 436
- Amino Acid Composition of Proteins and Foods, 431
  - Food Materials, 432
  - Protein Deficiencies as Causes of Corneal Vascularization, 194
- p-Aminobenzoic Acid, Assay, 397
- Ammonium Compound, High Molecular Quaternary, Deathrate Study with *Bacillus metiens*, 734
- Analogy, Concept of, and Anatomy, 578
- Anatomy and Concept of Analogy, 578
- Anemia Associated with Chronic Infection, 72
  - Granulocytopenia in Rats Fed Diets of Low Casein Content, 646
- Anesthesia, Continuous, for Insects, 57
- *Anomalepsis* and *Liotyphlops*, Hyobranchia in, vs. Pectoral Girdles, 720
- Anoxia, Altitude, in Provoking Relapse in Malaria, 223
- Anthropologists, and Atomic Bomb, 570
- Antibacterial Action of Phenanthrene-related Substances, 670
  - Protamine Zinc Insulin, 445
  - Streptomycin, Interference by Reducing Agents, 399
- Antibiotics, Convulsive Effects on Cerebral Cortex, 116
  - Differentiation by Resistant Strains, 673
  - Presumptive Identification of, 402.
  - Subtilin and Others, Physical and Biologic Properties, 419
- Antibody, Blocking, and Zone Phenomenon in Human Anti-Rh Sera, 389
- Antigen, Syphilis, Chemical Nature, 455
- Antimalarial Herb, Ch'ang Shan, 59
- Antipurpuric Action of A-Tocopherol, 762
- Anti-Rh Sera, Blocking Antibody and Zone Phenomenon in Human, 389
- Antiseptic, Intestinal: 2-Sulfanilimido-5-carboxythiazole, 719
- Antitoxic Units, Ambiguity of International, 423
- Antiulcer Substance, Shay Rat for Assay, 673
- Apoferritin and Ferritin, Protein, in Iron Feeding and Absorption, 107
- Aquatic Birds, Apparatus for Determining Respiratory Volume of, 171
- Arctic Institute of North America, 452
- Arginine-free Diets and Intestinal Synthesis of Arginine, 654
- Armored Medical Research Laboratory, Fort Knox, Kentucky, Reorganization, 232
- Ascorbic Acid, 2,4-Dinitrophenylhydrazine for Determination, 202
  - Inhibition of Oxidation by Certain Vegetable Extracts, 201
  - West Indian Cherry, High Content, 219
- *Aspergillus*, 116
  - Or What, 735
- Association Affairs
  - Audit of Financial Records for 1944, 250
  - Building Site Purchase, 591
  - Committee, Special, on Constitution and Bylaws: Statement on Revision of Constitution, 245
  - Conant, James Bryant, President, 1946, 191
  - Constitution, Revision: Statement by Special Committee on Constitution and Bylaws, 245
  - Financial Records, Audit for 1944, 250
  - Gibson Island Conference Program, Ninth, 259
  - K, Section, Work for, 105
  - Meeting, 112th, 1945, 506
    - Council Meeting, 507
    - Exhibition, 273; 367
    - Notes, 262; 263; 269; 428
    - Presidential Address, 377
    - Sections and Societies, 510
    - St. Louis, Housing Arrangements in, 231
  - Officers, AAAS Election, 9
  - Plea for Change in Regular Tim of AAAS Meeting, 178
  - Purchase of Washington Buildi Site, 591
  - Science Writers Annual Award, 1
  - September Meeting, Support 371
- Atomic Bomb. (Also see Nucl.
  - Anthropologists and, 570
  - Fission Bomb.)
  - Bomb, The Neutron, and Inte mediate or Compound Nucleu. 289
  - Bombing of Naval Vessels, Objections, 236
  - Energy, Domestic Control, 133
  - Energy, McMahon Bill for Domestic Control Passed by Senate, 689
  - Energy, Petition for International Control, Rutgers University, 232
  - Fission, Proposed 50–50 Control by Social and Physical Scientists, 370
  - Novae, and, 760
  - Research, Abandonment, 158; 488.
  - Research, Institute, Iowa State College, 16
  - Warfare, Prevention of, 177
- Austria, Sending Reprints, 635

B

- B Virus, Japanese, in Sera of Okinawan Horses, Complement-fixing and Neutralizing Antibodies, 357
- B.S. Degree, 733
  - Need for Meaningful, 438
- *Bacillus lentimorbus* Dutky and *Bacillus popilliae* Dutky, Competition 371
- *Bacillus metiens*, Death-rate Study High Molecular Quaternary Am monium Compound with, 734
- *Bacillus popilliae* Dutky and *Bacillus lentimorbus* Dutky, Competition, 371
- *Bacillus subtilis*, Inhibiting Substances against in Normal Serum, 363
- Bacterial Decomposition of Cellulose, Carbon Dioxide as Essential Fac-tor, 673
  - Resistance and Susceptibility to Sulfonamides and Penicillin, De-termining, 454
- Bactericidal Property of *Tergitol* Useful Selective, 758
- Baths CO_2, to Prevent Foaming, 23
- Beckmann Rearrangement of Aliphati Ketoximes, 503
- Behavior, Freezing in Rats, 27
- Betaine, Choline, and Methionine, Interrelations, 722
- Biarritz American University, Science Section, 129
- Bio-assay, Metabolic, Method: Inhibition of Fungus Respiration, 484
- Biochemistry, Department, Harvard University, 530
- Biological Films, Abstracting of, 206.
  - Theory, and Genetics, 570
- Biologies, Different, Yet One World, 206
- Biology, American Institute, Proposal, 692
  - College and High School, 598
  - Introductory Courses, 543
  - Soviet, 86

Biometeorology, and Geopathology, 816
Bison Quarry, Fossil, Plainview, Texas, 632
Black Fly Incubator-Aerator Cabinet, 21
Blood Group Factors and Ethnic Relationships, 284
  Group Factors and Racial Relationships, 147
  Parasites of Blue Grouse, 708
  Penicillin Levels after Oral Administration with Various Antacids, 353
  Phenols, Impurity in Penicillin Preparations Interfering With Diazo Reaction in Determining, 114
  Red Cell Content of Thoroughbred Horse, 73
  "Relationship," 600
Blue Licks Spring, Kentucky, Pleistocene Fossil Excavations, 58
Board for the Coordination of Malarial Studies, Wartime Research, 8
Body Fluids, Streptomycin in, 56
Books. (See Reviews.)
Brain Involvement as Cause of Relapse in Spirochetal Relapsing Fever, 422
British Anti-Lewisite, Canadian Researches, 439
Buckwheat as a Source of Rutin, 197
Buffaloes, Virus Encephalomyelitis in, 344
Bunchy Top, Transmission by Leaf Hopper of Genus *Empoasca*, 316
Burnett, Theodore Crété, 384
Bush Report, Statement on S. 1850 by Committee Supporting, 558
Butter-Margarine Controversy, 183

C

Cabbage, Dehydroascorbic Acid in, 196
Cahuilla, Age of Lake, 235
Calcium Phosphates, Deposition Accompanying Senile Degeneration and Disease, 326
California, University, Division of Medical Physics, 15
  Nuclear Physics Program, 754
  School of Forestry, 526
Camera, Lifwynn Eye-movement, 628
Can We Curb the Irresponsibles?, 349
Canadian Researches on British Anti-Lewisite, 439
Cancer Research and Benefit to Patients, 714
  Uterine, and Menorrhagia, Thiamine Deficiency and High Estrogen Findings, 441
Carbon 13, Plants to Produce, 82
Carbon Dioxide as Essential Factor in Bacterial Decomposition of Cellulose, 673
Carbon Tetrachloride, Effect of Methionine Supplements on Hepatic Injury Produced by, 199
Carcinogenic Substances from Pituitary Glands of Cattle, 556
Caribbean Research Council, Organization, 452
Carica papaya L., Transmission of Bunchy Top by Leaf Hopper of Genus *Empoasca*, 316
Carlsbad Caverns, New Mexico, Algae in, 175
"Carolina Bay," Age of Jerome Bog, 14
Carotene in Kale, 498
  Ratio to Carotenoid Pigments in Sweet-potato, 193
Carotenoid Pigments in Sweet-potato, Ratio of Carotene to, 193
Carotenoids and Vitamin A in Fowl, Apparent Antagonism, 584
Casein, Low, Granulocytopenia and Anemia in Rats, 646
Cattle, Carcinogenic Substances from Pituitary Glands, 556
Caventou and Pelletier Monument in Paris, 25
Cells, Mammalian Red, Target Area, 331
Cellulose, Carbon Dioxide as Essential Factor in Bacterial Decomposition, 673
Cerebral Cortex, Convulsive Effects of Antibiotic Agents on, 116
Cestode "Parasitized" by Acanthocephalan, 762
"Chain Reaction," Another, 158; 488
Ch'ang Shan, Chinese Antimalarial Herb, 59
Chemical Warfare Service, Special Projects Division, Plant Growth Regulators, 469
Chemicals, Rapid Estimation of Phytocidal Action, 474
Chemistry, Steric Effect in Organic, 385
Cherry, West Indian, High Ascorbic Acid Content, 219
Chick Embryo, Growth and Distribution of Murine Encephalomyelitis, 499
  Rations, Activity of Synthetic Folic Acid, 682
Chloride-free Filter Paper, 568
B-Chloroethyl Amines and Sulfides, Biological Actions and Therapeutic Applications, 409; 436
Chloroplasts, Frozen, Dried, and Homogenized, Evolution of Oxygen From Illuminated Suspensions, 505
Choline, Betaine, and Methionine, Interrelations, 722
Clarite X, Preservation of Biological Specimens With, 175
Clark, Bruce Lawrence, 302
Clostridium botulinum Type A Toxin, Purification and Crystallization, 613
Cold and Heat, Reflections on Cause, 487
College Biology, 598
Committee, Advisory, on Scientific Personnel, 438
  National Science Foundation Supporting the Bush Report. (See Bush Report.)
Conant, James Bryant, 191
Conditioning, Spinal in Dogs, 49
Congressional Sessions, Broadcasting, 370
Consultant Articles for Testing Validity of Scientific Evidence, 541
Coproporphyrin Isomers (I and III), Quantitative Differentiation of Minute amounts Based on Fluorescence Behavior, 338
Corn, Hybrid Seed, 547
Corneal Vascularization, Amino Acid and Protein Deficiencies as Causes, 194
Cover-Glass Preparations, Glass Device for Staining, 23
Cow, Prepartum Diet and Vitamin A Reserves of Offspring, 616
Crossing-over, Occurrence of Mitotic without Meiotic, 553
Crystallographic Data, X-ray, on DDT, 25
Culture Method for Certain Marine Algae, 112
Cup-plates, Agar, Sterile Technic for Preparing, 172
Curare, Misconceptions Regarding the New Clinically Adequate, 147
Curium, Proposed Name for Element 96, 481
Cutaneous Sensations in Man, Effect of DDT, 654

D

DDT, Cockroach, Site of Action, 304
  Cutaneous Sensations in Man, Effect, 654
  New Use, 459
  X-ray Crystallographic Data on, 25
Dallenbach, John Wallace, Fellowship in Psychology, 140
Daniels, Farrington, Nuclear Pile for Production of Power, 532
Deaf, Central Institute in St. Louis, Hearing-Aid Project, 448
Degeneration and Disease, Senile, and Deposition of Calcium Phosphates, 326
Degree, B.S., 733
  Need for Meaningful, 438
Dehydroascorbic Acid in Cabbage, 196
Democracy, Science for, 65
Denmark, Reprints to, 673
Dental Teaching and Research in Great Britain, 20
Desiccators, Opening "Frozen" Vacuum, 26
Detoxification by Acetylation of Soluble Antigens from *Shigella dysenteriae* (Shiga) and *E. typhosa*, 387
Diabetes by Feeding Alloxan to Cats, 220
Diazo Reaction in Determining Blood Phenols, and Impurity in Some Commercial Penicillin Preparations, 114
TDE, 1,1-Dichloro-2,2-bis (p-chlorophenyl) ethane, as an Anopheline Larvicide, 13
2,4-Dichlorophenoxyacetic Acid. (See Herbicides.)
Dilemma, Man's, and Science, 241
2,4-Dinitrophenylhydrazine for Determination of Ascorbic Acid, 202
Disease and Degeneration, Senile, and Deposition of Calcium Phosphates, 326
Distemperoid Virus Interference in Canine Distemper, 497

Distribution Studies, Identification of Small Amounts of Organic Compounds by. IV: Use of Solid Phase, 587
Divalent Cation and Solubility of Triple Acetate Salt of Sodium, 420
Dogs, Distemperoid Virus Interference in Distemper, 497
  Hemoglobin, Inactive, in Blood, 406.
  Ovaries Transfer in Different Breeds, 654
  Spinal Conditioning in, 49
  Streptomycin, Absorption and Excretion, 364
Dudley Herbarium, Recent Additions, 459

E

Earthquakes and Nuclear Fission Bomb, 674
Eberthella typhosa and *Shigella dysenteriae* (Shiga), Detoxification by Acetylation of Soluble Antigens, 387
Edema, Famine, and Mechanism, 669
Educational Research, Nature and Need, 657
Eggs, Motherless Males from Irradiated, 219
Eichornia crassipes, Herbicidal Action of 2,4-Dichlorophenoxyacetic Acid, 477
Electrodes, Electroencephalographic, Attachment, 22
Electroencephalographers, Eastern Association, 394
Electroencephalographic Electrodes, Attachment of, 22
Elements 95, 96, 481
Emerita pacifica (Sand Crab), Portuguese Man-of-war as a Food Source, 148
Empoasca, and Transmission of Papaya Bunchy Top, 316
Encephalomyelitis Virus, in Buffaloes, 344
  Murine, in Developing Chick Embryo, 499
Entomogenous Bacteria, Competition between Two, 371
Enzymic Digestion of Proteins as Factor in Nutrition, 326
Epidemic and Murine Typhus, Specificity, 330
Ergograph, Modification, 731
Erythroblastosis, Treatment by Simultaneous Removal and Replacement of Blood of Infant, 583
Estrogen in Uterine Cancer and Menorrhagia, 441
Ethnic Relationships and Blood Group Factors, 284
Ethnopathology or Geopathology, 694
Europe, Packages to Scientists, 599
  Western, Packages to Scientists, 372
''Exact'' Natural Sciences, Critique, 235
Exclusion Principle, Remarks on History of, 213
Experimentally Deformed Rocks, 99.
Exudates, Inflammatory, and Leukopenic Factor, 648
Eye-movement Camera, Lifwynn, 628

F

Famine Edema and Mechanism of Its Formation, 669
Feathers and Fur: Response to Falling Temperature, 74
Federal Scientific Research, 206
Fibrosarcoma, Induced, Susceptibility to, and Black Pigmentation—Linkage and Crossing-over between, 554
Films, Biological, Abstracting, 206
Filter Paper, Chloride-free, 568
Fish, Effects of New Herbicides, 487
Fishes, Rains of, Myth or Fact, 693; 713
Fixatives, Histological, Use of Wetting Agents, 731
Flounders, Winter, Reversed, 174; 488
Flowmeter, Indicating, and Low-resistance Valve for Respiratory Measurements, 537
Fluorescence Behavior, Quantitative Differentiation of Minute Amounts of Coproporphyrin Isomers (I and III) Based on, 338
  Radium Burns, 631
Fluorometric Determination of Nicotinamide, 567
Folic Acid. (See *L. casci.*)
Food Acceptance Research, 187
Forestry, School of, University of California, 526
Fossil Bison Quarry, Plainview, Texas, 632
Free-hand Sections, Superior Pith for, 112
Freezing Behavior in Rats, 27
''Frenching'' Response of Tobacco Seedlings to Isoleucine, 329
Frog, Observations in Dissections, 632
Fungus Respiration Inhibition: A Metabolic Bio-assay Method, 484
Fur and Feathers: Response to Falling Temperature, 74
Fusarium Wilt in Tomato, Interpretation of Resistance, 707
Future, and Science, 415

G

Gamma Ferric Oxide, Colloidal, Radioactivation, 744
Gastric Mucigogue Action of Alkyl Sulfates, 50
Genetics and Biological Theory, 570
Geology, Veterans' Retraining Program, 177
Geopathology, Biometeorology, Branch of, 316
  Or Ethnopathology, 694
German Agricultural and Biological Chemists, Recent and Current Work, 534
Glacial Map of North America, 627
Glass Disks, Sintered, 21
Glutamine from Rye Grass, 206
B-glycoside Formation in Plants From Absorbed Chemicals, 458
Goodrich, B. F., Company, New Research Laboratories, 140
Government Research, Reply to Professor Reed, 85
Government Subsidies and Science, 761
Granulocytopenia and Anemia in Rats Fed Diets of Low Casein Content, 646
Great Britain, Alliance of Industry and Scientific Research, 6
  Dental Teaching and Research, 20
  Government Support for Research Associations, 20
Grouse, Blue, Blood Parasites, 708
Growth Regulators, Plant, 469

H

H.R. 6448, 687
  Why the Better Bill, 724
Hanson, Frank Blair, 143
Haploidy as Factor in the Polymorphic Differentiation of the Hymenoptera, 555
Harvard University, Department of Biochemistry, 530
  Department of Social Relations, 393
  Psycho-Acoustic and Electro-Acoustic Laboratories, Hearing-Aid Project, 448
  School of Public Health, Reorganization, 110
Haustellate Insects, Potometer for Rapid Measurements of Ingestion, 22
Hearing-Aid Project, OSRD, 448
Heat and Cold, Reflections on Cause, 487
Hemoglobin, Inactive, in Blood of Ophidia and Dogs, 406
  Regeneration, Effect of B-Pyracin and *Lactobacillus casei* Factor on, 303
Hemolytic Streptococcal Sore Throat: Antibody Response Following Treatment with Penicillin, Sulfadiazine, and Salicylates, 353
Hemophilia, Thromboplastic Studies, 402
Hemostatic Agent, New and Effective, 634
Hepatic Injury Produced by Carbon Tetrachloride, Effect of Methionine Supplements on, 199
Herbaria, Foreign, and Museums, Present Status, 282
Herbarium, Dudley, Recent Additions, 459
Herbicides. (Also see Phytocides.)
  2,4-Dichlorophenoxyacetic Acid, Herbicidal Action on Water Hyacinth *Eichornia crassipes*, 477
  2,4-Dichlorophenoxyacetic Acid, Treatment of Muck and Manure to Inhibit Germination of Weed Seeds, 476
  2,4-Dichlorophenoxyacetic Acid, Control of Ragweed Pollen, 473
  2,4-Dichlorophenoxyacetic Acid and Similar Substances, Tributyl Phosphate as Solvent, 476
  2,4-Dichlorophenoxyacetic Acid as Selective Herbicide in Tropics, 472
  Effects of New, on Fish, 487
High School Biology, 598
  Science, 149; 317
  Science Training, Recognition, 458
Hispanic America Map, 319
  Congratulatory Address, 323
Histochemical Method for Localizing Adenosinetriphosphatase, 144
Historical Record, and Metric System, 783
Holt, Edwin Bissell, 612
Hormonal Action, Sex, and Chemical Constitution, 221

Horse, Thoroughbred, Red Cell Content of Blood, 73
Houdry Process Corporation Plant to Produce Carbon 13, 82
Hyaluronidase Inhibition by Sodium Salicylate in Rheumatic Fever, 686
Hybrid Seed Corn, 547
Hydraulic Artificial Leg, 753
Hydrolysates of Proteins, Intravenous Utilization of Partial Acid, 362
Hymenoptera, Haploidy as Factor in the Polymorphic Differentiation, 555
Hyobranchia in Snake Genera *Liotyphlops* and *Anomalepsis* vs. Pectoral Girdles, 720

I

Ice Age, and Temperatures in Deep Wells, 541
Identification of Small Amounts of Organic Compounds by Distribution Studies. IV: Use of Solid Phase, 587
Immer, Forrest Rhinehart, 751
Incubator-Aerator Cabinet, Black Fly, 21
Industrial View of Research Trends, 95
Industry and Scientific Research, Alliance in Great Britain, 6
Infection, Chronic, and Anemia, 72
Inositol, Lipotropic Properties of, 12
Insects, Continuous Anesthesia, 57
  Haustellate, Potometer for Measurements of Ingestion, 22
Institute for Research in Clinical and Child Psychology, 530
Insulin, Protamine Zinc, Antibacterial Activity, 445
International Antitoxic Units, Ambiguity, 423
  Association of Scientists, Proposed, 148
  Atomic Energy, Control, Petition by Faculty of Rutgers University, 232
  Commission on Zoological Nomenclature, 655
Intestinal Antiseptic: 2-Sulfanilimido-5-carboxythiazole, 719
  Synthesis of Arginine, 654
Iodine, Mechanism of Therapeutic Effect on Thyroid Gland, 421
Iowa State College, Institute of Atomic Research, 16
  Tropical Research Center, 139
Iron Feeding and Absorption, Protein Apoferritin and Ferritin in, 107
Irradiated Eggs, Motherless Males from, 219
Irresponsibles, Are Scientists, 572
  Can We Curb, 349
Isoleucine, "Frenching" Response of Tobacco Seedlings to, 329
Isotopes, Availability of Radioactive, 697

J

Japan, War and Biological Sciences, 755
Japanese B Virus in Sera of Okinawan Horses, Complement-fixing and Neutralizing Antibodies, 357
  Scientific Men, 597
Jerome Bog, A "Carolina Bay," Age of, 14
Journal of Personality, 596

K

Kale, Availability of Carotene, 498
Kernicterus, Pathogenesis, 570
Ketoximes, Aliphatic, Beckmann Rearrangement, 503
Kilgore-Magnuson Bill, S. 1850, Note, 430
  Text of New, 225

L

Laboratories, Research Service, 542
Lactobacillus casei Factor and B-Pyracin, Effect on Hemoglobin Regeneration after Hemorrhage, 303
  Liver Factor, Structure and Synthesis, 667
  Synthetic, Factor in Treatment of Sprue, 108
  Synthetic, in Purified Rations for Chick, 682
Larvicide, Anopheline, TDE, 1,1-Dichloro-2,2-bis (p-chlorophenyl) ethane, as, 13
Leg, Hydraulic Artificial, 753
Legislative Promotion of Science and Science Teacher, 68
Leukopenic Factor in Inflammatory Exudates, 648
Lifwynn Eye-movement Camera, 628
Light Absorption, and Molecular Weights of Viruses, 306
Lima Bean, Seed Pitting by Lygus Bugs in California, 500
Liotyphlops and *Anomalepsis*, Hyobranchia in, vs. Pectoral Girdles, 720
Liponyssus bacoti, Transmission of *Litomosoides Carinii* by, 224
Lipotropic Properties of Inositol, 12
Litomosoides Carinii, Transmission by *Liponyssus bacoti*, 224
Liver Fat, and Pancreatic Enzymes, 207
  L. casei Factor, Structure and Synthesis, 667
Luminescence, Law of Precharged, 178
Luminescent Materials, Uniform, 155
Lygus Bugs, Seed Pitting of Lima Bean by, 500
Lynch, D. F. J., 332

M

McClung, Clarence Erwin, 551
McDonald Observatory, 342
McLaughlin, George Dunlap, 418
McMahon Bill for Domestic Control of Atomic Energy, Passed by Senate, 689
Malaria, Altitude Anoxia in Provoking Relapse, 223
  Antimalarial Herb, Ch'ang Shan, 59
  Rainfall Periodicity in Palestine, 342; 344
  Vivax, Naturally Induced, Relapses Following Delayed Treatment, 391
  Wartime Research in, 8
Mammalian Red Cells, Target Area, 331
Maney, Thomas J., 302
Manhattan Project, Announcement on Availability of Radioactive Isotopes, 697
Manure, Treatment with 2,4-Dichlorophenoxyacetic Acid to Inhibit Germination of Weed Seeds, 476
Map, Glacial, North America, 627
  Hispanic America, Millionth, 319; 323
Margarine-Butter Controversy, 183
Marine Algae, Culture Method for, 112
  Animals, Fluctuations in Abundance, 684
  Laboratory, Tropical, Functions and Development, 609
Martin, Glenn L., Gift to University of Maryland for Aeronautical Engineering School, 139
Maryland, University, Gift for Aeronautical Engineering School, 139
Mathematical Association of America and American Mathematical Society, Statement, Statement on Universal Military Service, 579
May, Alan Nunn, Sentence, Criticism by Association of Scientific Workers of Great Britain, 754
Measurement, Theory of Scales, 677
Medical Research Mission to Soviet Union, I, II, 605; 637
Medicine, Impact of War on, 575
Menorrhagia, Thiamine Deficiency and High Estrogen Findings, 441
Merriam, John Campbell, 470
Metabolism Apparatus, Modification, 341
Meteorite, New Pennsylvania, 694
Methionine, Choline, and Betaine, Interrelations, 722
  Supplements, Effect on Hepatic Injury Produced by Carbon Tetrachloride, 199
Metric System and Historical Record, 733
  Note, 634
Meyer, Bernard S., Editor-in-chief, *American Journal of Botany*, 448
Microscope Slides, Cleaning, 456
Microscopy, Electron, Vibrating Muller for Preparing Dispersions of Fine Pigments, 429
Military Service, Universal, in Peacetime, 579
Millionth Map of Hispanic America, 319
Mitotic Crossing-over without Meiotic Crossing-over, 553
Mold Product, and Inhibition of Growth of *Mycobacterium Tuberculosis*, 167
  Superior strain, and Penicillin Production, 504
Morgan, Thomas Hunt, 550
Motors, Air-stirring, Silencing, 429
Mouse, Effect of Temperature on Susceptibility to Poliomyelitis Virus, 137
Mucigogue Action Gastric, of Alkyl Sulfates, 50
Mud Cracks, Subaqueous, Formed by Settling, 85
Muller, Vibrating, For Preparation of Dispersions of Pigments for Electron Microscopy, 429
Multiple Factor Theory of Control of Respiratory Ventilation, 739

Murine and Epidemic Typhus, Specificity, 330
Muscle, Skeletal, Nucleosis: Its Value as a Biological Test, 566
Museum of Science and Industry, 342
Museums and Foreign Herbaria, Present Status, 282
Mycobacterium Tuberculosis, Inhibition of Growth by a Mold Product—Effect on Pathogenic Human Tubercle Bacilli, 167

N

N_2O, Atmospheric, Possible Source, 280
National Mental Health Act, Endorsed by New York Academy of Medicine, 754
National Science Foundation, Committee for, 11; 45
  Compromise Bill, 192
  Practical Reality or a Perpetual Controversy? 104
  S. 1850, Final Senate Bill, 270
  Safeguarding Science, 430
  Scientific Worker, 4
  Statement by Senator Raymond E. Willis Introducing Bill, 163
Natural Sciences, "Exact," Critique, 235
Naval Research Laboratory, Office of Research and Inventions, New Psychology Section, 393
Nerve Injury, Electrical Correlates, 48
Neutron, Intermediate of Compound Nucleus, and Atomic Bomb, 289
New Opportunities and Responsibilities for the Psychologist, 33
Nicotinamide, Fluorometric Determination, 567
Nitrogen, Soil, and Thrips Injury to Spinach, 331
Nobel Prize, 1945, Encomium, 216
  Introductory Remarks, 215
  Wolfgang Pauli Address, Remarks on History of Exclusion Principle, 213
Northwestern University, New Department of Geography, 336
Novae, and Atomic Bombs, 760
Nuclear Energy. (Also see Atomic Energy.)
  vs. Atomic or Chemical Energy, 147.
  Energy and Polar Icecap, 316
  Fission Bomb as Initiator of Earthquakes, 674
  Research Institute at Oak Ridge, 705
Nuclear Physics Program, University of California, Los Angeles, 754
Nucleosis of Skeletal Muscle: Its Value as a Biological Test, 566
Nutrition, Rate of Enzymic Digestion of Proteins as a Factor, 326

O

Obituaries
  Burnett, Theodore Crété, 384
  Clark, Bruce Lawrence, 302
  Hanson, Frank Blair, 143
  Holt, Edwin Bissell, 612
  Immer, Forrest Rhinehart, 751
  McClung, Clarence Erwin, 551
  McLaughlin, George Dunlap, 418
  Maney, Thomas J., 302
  Merriam, John Campbell, 470
  Morgan, Thomas Hunt, 550
  Wheeler, Homer Jay, 751
Oak Ridge, Nuclear Research Institute, 705
Oceanograph Division, U. S. Navy Hydrographic Office, 528
Oceanographic Surveys, Use of Aircraft, 635
Ophidia, Inactive Hemoglobin in Blood, 406
Organic Compounds, Identification of Small Amounts by Distribution Studies. IV: Use of Solid Phase, 587
Ovaries, Transfer Between Dogs of Different Breed, 654
Oxygen, Evolution from Illuminated Suspensions of Frozen, Dried, and Homogenized Chloroplasts, 505
  Instrument for Determining Partial Pressure of, in a Gas, 338

P

Palestine, Malaria and Rainfall Periodicity, 342; 344
Pancreatic Enzymes and Liver Fat, 207
Pantoyltaurine, Antagonism of Salicylate, 398
Papaya. (See *Carica papaya* L.)
Paramecium, Method of Growing Dense Cultures, 115
Partial Pressure of Oxygen in a Gas, Instrument for Determining, 338
Pectin, Characterization, 166
  Intravenously, 280
Pectoral Girdles vs. Hyobranchia in Snake Genera *Liotyphlops* and *Anomalepis*, 720
Peking Man Returned to China, 451
Pelletier and Caventou Monument in Paris, 25
Penicillin, Absorption of Orally Administered, 359
  Alcaligenes fecalis, Effect on Growth, 361
  Bacterial Resistance and Susceptibility, 454
  Blood Levels After Oral Administration With Various Antacids, 353
  Continuous Parenteral Administration, 759
  Hemolytic Streptococcal Sore Throat, 352
  Impurity in Some Commercial Preparations Interfering with Diazo Reaction in Determining Blood Phenols, 114
  Inactivation by Zinc Salts, 629
  K, Low Therapeutic Activity Relative to Penicillins F, G, and X, and Pharmacological Basis, 618
  Production by Superior Strain of Mold, 504
  Tyndall John, Observations, 1876, 232
  X, Oral, 501
  X, Production in "Submerged" Surface Cultures, 535
Penicillins, G, X, and K, Relative Effectiveness, 709
Pennsylvania Meteorite, 694
  University Thermodynamics Research Laboratory, 560
Perfusing Apparatus, Pulsating, 170
Peripheral Nerve Injury, Electrical Correlates, 48
Personality, Journal of, 596
Phenanthrene-related Substances, Antibacterial Action, 670
Phenol Vapors, Absorption by Plants, 207
Photographic Method for Recording Ureteral Kinetics in Situ, 55
Physical Society of Pittsburgh. Report on Science Legislation, 383
  Thinking and Social Problems, 717
Physics, Medical, New Division, University of California, Berkeley, 15
Phytocidal Action of Chemicals, Rapid Estimation, 474
Pigmentation, Black, and Susceptibility to Induced Fibrosarcoma in Mice, Linkage and Crossing-over, 554
Pith, Superior, for Free-hand Sections, 112; 695
Pituitary Glands of Cattle, Carcinogenic Substances from, 556
Pittsburgh, Physical Society, Report on Science Legislation, 383
Plainview, Texas, Fossil Bison Quarry, 632
Planets, Radio Echoes from, 371
Plant Growth Regulators, 469
Plasmodia, Staining, 630
Pleistocene Fossil Excavations at Blue Licks Spring, Kentucky, 58
Polar Icecap and Nuclear Energy, 316
Poliomyelitis Virus, Effect of Temperature on Mouse Susceptibility to, 137
Portuguese Man-of-war as Food Source for *Emerita pacifica* (Sand Crab), 148
Potometer for Rapid Measurement of Ingestion by Haustellate Insects, 22
Prepartum Diet of Cow and Vitamin A Reserves of Offspring, 616
Pressure-regulating Device, Automatic for Use with Vacuum Lines, 145
Priest Bill (S. 1160 and H.R. 4512) Endorsed by New York Academy of Medicine, 754
Protamine Zinc Insulin, Antibacterial Activity, 445
Protein and Foods Amino Acid Composition, 431
  Amino Acid Deficiencies as Causes of Corneal Vascularization, 194
  Apoferritin and Ferritin in Iron Feeding and Absorption, 107
  Enzymic Digestion, Rate of, as a Factor in Nutrition, 326
  Hydrolysates and Amino Acids, Studies by Rutgers University, Pharmaceutical Manufacturers and Army, 205
  Intravenous Utilization of Partial Acid Hydrolysates, 362
Prozones and Blocking Effect in Normal Iso- and Hetero-Agglutination with Cord Sera, 76
Psychologist, New Opportunities and Responsibilities for, 33
Psychology, Clinical and Child, Institute for Research, 530
  Dallenbach, John Wallace, Fellowship, 140
  Function, 280
  Section, Naval Research Laboratory, Office of Research and Inventions, 393

Pulsating Perfusing Apparatus, 170
"Purple" Test for Alloxan, 634
B-Pyracin and *Lactobacillus casei* Factor, Effect on Hemoglobin Regeneration After Hemorrhage, 303

R

Rabbit, Growth of Trophoblast in Anterior Chamber of Eye, 25
Radiation, Violet, Apparent Visible, in Recent Large Sunspot Group, 681
Radioactivation of Colloidal Gamma Ferric Oxide, 744
Radioactive Isotopes, Availability, 697
Radioactivity, New Units for Measurement, 712; 761
Radio Echoes from the Planets, 371
Radium Burns, Fluorescence, 631
Ragweed Pollen, Control with 2,4-Dichlorophenoxyacetic Acid, 473
Random Functions, Recent Contributions to Theory, 283
Rats, Freezing Behavior in, 27
  Granulocytopenia and Anemia in, 646
  Senile White, Effects of Sex Hormones on Copulatory Behavior, 749
  Shay, for Assay of Antiulcer Substance, 673
  Sterility Induced on Tryptophane-deficient Diet, 137
  Tocopherols in Preventing Gastric Ulcers, 586
Recording Ureteral Kinetics in Situ, Photographic Method, 55
Red Cell Content of Blood of Thoroughbred Horse, 73
Relapsing Fever, Spirochetal, Brain Involvement, 422
Research Associations in Great Britain, Government Support, 20
  Atomic, Institute at Iowa State College, 16
  Cancer, and Benefit to Patients, 714
  Council, Organization of Caribbean, 453
  Educational, Nature and Need, 657
  Federal Scientific, 206
  Developing Food Acceptance, 187
  Institute, Nuclear, at Oak Ridge, 705
  Medical, Mission to Soviet Union, I, II, 605; 637
  Malaria, Wartime, 8
  Scientific, and Industry in Great Britain, 6
  Scientific in Postwar Era, 125
  Scientific Support of, 543
  Service Laboratories, 542
  Stations, Regional, in Basic Science, 403
  Trends, Industrial View, 95
Researcher, The Little, 493
Researches, Canadian, on BAL, 439
Respiratory Measurements, Low-resistance Valve and Indicating Flowmeter, 537
  Tract, Water Loss in Sub-tropics, 281
  Ventilation, Control, Multiple Factor Theory, 739
  Volume of Large Aquatic Birds, Apparatus for Determining, 171

Reviews.
Books reviewed by author
  Amsden, John Page, Physical chemistry for premedical students, 716
  Anson, M. L., and Edsall, John T. (Eds.), Advances in protein chemistry, 210
  Atherton, Ralph, Principles of radio for operators, 374
  Bailey, Alton E., Industrial oil and fat products, 210
  Bamann, Eugen, and Myrbäck, Karl, Die Methoden der Fermentforschung, 736
  Barron, Harry, Modern plastics, 603
  Boring, Edwin, Psychology for the armed services, 90
  Bray, A., Russian-English scientific-technical dictionary, 89
  Broster, L. R., Endocrine man: a study in the surgery of sex, 696
  Brues, Charles T., Insect dietary: an account of the food habits of insects, 545
  Bunn, C. W., Chemical crystallography: an introduction to optical and X-ray methods, 573
  Columbia University Statistical Research Group, for Applied Mathematics Panel, NDRC, Sequential analysis of statistical data: applications, 490
  Darlington, C. D., and Ammal, E. K. Janaki, Chromosome atlas of cultivated plants, 736
  De Jong, H. Holland, Experimental catatonia, 28
  De Ment, Jack, Fluorochemistry, 763
  De Ment, Jack, and Dake, H. C., Uranium and atomic power, 240
  Dougherty, Joseph M., and Lamberti, Anthony J., Textbook of bacteriology and immunology, 738
  Drinker, Cecil K., Pulmonary edema and inflammation, 544
  Dubos, René J., The bacterial cell, 462
  Du Noüy, Lecomte, Studies in biophysics: the critical temperature of serum (56°), 374
  Dvorine, Israel, Dvorine color perception testing and training charts, 545
  Fitzgerald, A. E., Basic electrical engineering, 574
  Freedman, Samuel, Two-way radio, 490
  Frier, W. T., and Holler, Albert C., Introduction to industrial chemistry, 30
  Gesell, Arnold, How a baby grows: a story in pictures, 60
  Goldziehir, Max A., Endocrine Glands, 696
  Grinker, Roy R., and John P. Spiegel, War neuroses, 348
  Grinter, L. E., et al., Engineering preview: an introduction to engineering including the necessary review of science and mathematics, 238
  Harris, Robert S., and Thimann, Kenneth V. (Eds.), Vitamins and hormones: advances in research and application, 210
  Herrick, Arthur D., New drugs, 676
  Herzberg, Gerhard, Infrared and Raman spectra of polyatomic molecules, 239
  Hobbs, William Herbert, Fortress islands of the Pacific, 181
  Höber, Rudolf, et al., Physical chemistry of cells and tissues, 286
  Hoffmann, Adolphe, Faune de France 44, 764
  Honig, Pieter, and Verdoorn, Frans (Eds.), Science and scientists in the Netherlands Indies, 764
  Hopkins, B. Smith, and Bailar, John C., Jr., Essentials of general chemistry, 656
  Horsfall, James G., Fungicides and their action, 87
  Johnson, Maxwell O., Correlation of cycles in weather, solar activity, geomagnetic values, and planetary configurations, 407
  Jordan, Edwin O., and Burrows, William, Textbook of bacteriology, 89.
  Jordan, Pascual, Physics of the twentieth century, 31
  King, Ronold W. P., Mimno, Harry Rowe, and Wing, Alexander H., Transmission lines, antennas and wave guides, 696
  Kleiner, Israel S., Human biochemistry, 376
  Leffingwell, Georgia, and Lesser, Milton, Soap in industry, 676
  Liddell, Donald M., Handbook of nonferrous metallurgy, Pt. II, 636
  Lillie, Frank R., Woods Hole Marine Biological Laboratory, 182
  Lowy, Alexander, et al., Introduction to organic chemistry, 30
  Lush, J. L., Animal breeding plans, 406
  Lyons, Sir Henry, The Royal Society 1660–1940, 435
  Lysenko, T. D., Heredity and its variability, 180
  McKee, Edwin D., and Resser, Charles E., Cambrian history of the Grand Canyon Region, 285
  Mainland, Donald, Anatomy as a basis for medical and dental practice, 119
  Markus, John, and Zeluff, Vin (Eds.), Electronics for engineers, 374
  Masserman, Jules H., Principles of dynamic psychiatry, 574
  Masters, Dexter, and Way, Katherine (Eds.), One world or none, 434
  Mawhinney, M. H., Heating of steel, 636
  Peters, James Lee, Check-list of birds of the world, 32
  Pigman, W. W., and Wolfrom, M. L., Advances in carbohydrate chemistry, 152

Rabinowitch, Eugene I., Photosynthesis and related processes, Vol. I, 460
Romer, Alfred Sherwood, Vertebrate paleontology, 88
Rousseau, Jacques, L'hérédité et l'homme, 87
Schwartz, Louis H., Your eyes have told me, 120
Sears, Francis Weston, Principles of physics III: optics, 346
Shreve, R. Norris, Chemical process industries, 347
Smart, W. M., Text-book on spherical astronomy, 122
Smith, James G., and Duncan, Acheson J., Sampling statistics and applications: fundamentals of the theory of statistics, 462
Snedecor, George W., Statistical methods: applied to experiments in agriculture and biology, 407
Stewart, John Q., Coasts, waves and weather for navigators, 89
Temkin, Owsei. The falling sickness: a history of epilepsy from the Greeks to the beginnings of modern neurology, 238
Tiselius, A., and Pedersen, Kai O. (Eds.), The Svedberg, 1884–1944, 738
Twiss, Sumner B. (Ed.), Advancing fronts in chemistry, 716
Vaughan, T. W., and Wells, J. W., American Old and Middle Tertiary larger Foraminifera and corals, 28
Villa R., Alfonso, The Maya of East Central Quintana Roo, 60
Warner, W. Lloyd, and Srole, Leo, The social systems of American ethnic groups, 150
Weissberger, Arnold (Ed.), Physical methods of organic chemistry, 285
Weygand, Conrad, Organic preparations, 408
White, M. J. D., Animal cytology and evolution, 602
ZoBell, Claude E., Marine microbiology, 715

Books reviewed by title
Advances in carbohydrate chemistry, W. W. Pigman and M. L. Wolfrom, 152
Advances in protein chemistry, M. L. Anson and John T. Edsall (Eds.), 210
Advancing fronts in chemistry. Vol. I: High polymers, Sumner B. Twiss (Ed.), 716
American Old and Middle Tertiary larger Foraminifera and corals, T. W. Vaughan and J. W. Wells, 28
Anatomy as a basis for medical and dental practice, Donald Mainland, 119
Animal breeding plans, J. L. Lush, 406
Animal cytology and evolution, M. J. D. White, 602
Bacterial cell, René J. Dubos, 462
Basic electrical engineering: circuits, machines, electronics, A. E. Fitzgerald, 574
Cambrian history of the Grand Canyon Region, Edwin D. McKee and Charles E. Resser, 285
Check-list of birds of the world, James Lee Peters, 32
Chemical crystallography: an introduction to optical and X-ray methods, C. W. Bunn, 573
Chemical process industries, R. Norris Shreve, 347
Chromosome atlas of cultivated plants, C. D. Darlington and E. K. Janaki Ammal, 736
Coasts, waves and weather for navigators, John Q. Stewart, 89
Correlation of cycles in weather, solar activity, geomagnetic values, and planetary configurations, Maxwell O. Johnson, 406
Die Methoden der Fermentforschung, Eugen Bamann and Karl Myrbäck, 736
Dvorine color perception testing and training charts, Israel Dvorine, 545
Electronics for engineers, John Markus and Vin Zeluff (Eds.), 374
Endocrine glands, Max A. Goldzieher, 696
Endocrine man: a study in the surgery of sex, L. R. Broster, 696
Engineering preview: an introduction to engineering including the necessary review of science and mathematics, L. E. Grinter, et al., 238
Essentials of general chemistry, B. Smith Hopkins and John C. Bailar, Jr., 656
Experimental catatonia, H. Holland de Jong, 28
Falling sickness: a history of epilepsy from the Greeks to the beginnings of modern neurology, Oswei Temkin, 238
Faune de France 44: Coléoptères bruchides et anthribides, Adolphe Hoffmann, 764
Fluorochemistry: a comprehensive study embracing the theory and applications of luminescence and radiation in physicochemical science, Jack De Ment, 763
Fortress islands of the Pacific, William Herbert Hobbs, 181
Fungicides and their action, James G. Horsfall, 87
Handbook of nonferrous metallurgy. Pt. II: Recovery of the metals, Donald M. Liddell, 636
Heating of Steel, M. H. Mawhinney, 636
Heredity and its variability, T. D. Lysenko, 180
How a baby grows: a story in pictures, Arnold Gesell, 60
Human biochemistry, Israel S. Kleiner, 376
Industrial oil and fat products, Alton E. Bailey, 210
Infrared and Raman spectra of polyatomic molecules, Gerhard Herzberg, 239
Insect dietary: an account of the food habits of insects, Charles T. Brues, 545
Introduction to industrial chemistry, W. T. Frier and Albert C. Holler, 30
Introduction to organic chemistry, A. Lowy, B. Harrow, and P. M. Apfelbaum, 30
L'hérédité et l'homme, Jacques Rousseau, 87
Marine microbiology: a monograph on hydrobacteriology, Claude E. ZoBell, 715
Maya of East Central Quintana Roo, Alfonso Villa R., 60
Modern plastics, Harry Barron, 608
New drugs, Arthur D. Herrick, 676
One world or none: a report to the public on the full meaning of the atomic bomb, Dexter Masters and Katherine Way (Eds.), 434
Organic preparations, Conrad Weygand, 408
Photosynthesis and related processes. Vol. I: Chemistry of photosynthesis, chemosynthesis and related processes *in vitro* and *in vivo*, Eugene I. Rabinowitch, 460
Physical chemistry of cells and tissues, Rudolf Höber, et al., 286
Physical chemistry for premedical students, John Page Amsden, 716
Physical methods of organic chemistry, Arnold Weissberger (Ed.), 285
Physics of the twentieth century, Pascual Jordan, 31
Principles of dynamic psychiatry: including an integrative approach to abnormal and clinical psychology, Jules H. Masserman, 574
Principles of physics III: optics, Francis Weston Sears, 346
Principles of radio for operators, Ralph Atherton, 374
Psychology for the armed services, Edwin G. Boring, 90
Pulmonary edema and inflammation, Cecil K. Drinker, 544
Royal Society 1660–1940: a history of its administration under its charters, Sir Henry Lyons, 435
Russian-English scientific-technical dictionary, A. Bray, 89
Sampling statistics and applications: fundamentals of the theory of statistics, James G. Smith and Acheson J. Duncan, 462
Science and scientists in the Netherlands Indies, Pieter Honig and Frans Verdoorn (Eds.), 764
Sequential analysis of statistical data: applications, (Statistical Research Group, Columbia Univ., for Applied Mathematics Panel, NDRC), 490
Soap in industry, Georgia Leffingwell and Milton Lesser, 676
Social systems of American ethnic groups, W. Lloyd Warner and Leo Srole, 150
Statistical methods: applied to experiments in agriculture and biology, George W. Snedecor, 407
Studies in biophysics: the critical temperature of serum (56°), Lecomte du Noüy, 374
Svedberg, 1884–1944, A. Tiselius and Kai O. Pedersen (Eds.), 738

  - Textbook of bacteriology, Edwin O. Jordan and William Burrows, 89
  - Textbook of bacteriology and immunology, Joseph M. Dougherty and Anthony J. Lamberti, 738
  - Textbook on spherical astronomy, W. M. Smart, 122
  - Transmission lines, antennas and wave guides, Ronold W. P. King, Harry Rowe Mimno, and Alexander H. Wing, 696
  - Two-way radio, Samuel Freedman, 490
  - Uranium and atomic power, Jack De Ment and H. C. Dake, 240
  - Vertebrate paleontology, Alfred Sherwood Romer, 88
  - Vitamins and hormones: advances in research and application, Robert S. Harris and Kenneth V. Thimann (Eds.), 210
  - War neuroses, Roy R. Grinker and John P. Spiegel, 348
  - Woods Hole Marine Biological Laboratory, Frank R. Lillie, 182
  - Your eyes have told me, Louis H. Schwartz, 120

- Rheumatic Fever, Hyaluronidase Inhibition by Sodium Salicylate, 686
  - Virus, Direct Culture, 620
- Rochester, University, Department of Physics, Expansion, 532
- Rocks, Study of Experimentally Deformed, 99
- Russia. (Also See Soviet Union.)
- Russia, Scientific Independence, 656
- Russian, Scientific, Study of in American Universities, 86
- Rutgers University Faculty, Petition for International Control of Atomic Energy, 232
  - Studies of Protein Hydrolysates and Amino Acids, 205
- Rutin, Buckwheat as a Source, 197
- Rye Grass, Glutamine from, 206

S

- S. 1720, 39
  - vs. 1777, 161
- S. 1777, 164
- S. 1850: Floor of the Senate, 382
  - Note, 430
  - Senate, 589
  - Statement by Committee Supporting Bush Report, 558
  - United Front for, 727.
  - Why the Better Bill, 724
  - Why in Favor, 725
- Salicylate, Antagonism by Pantoyltaurine, 398
- Salicylates, and Hemolytic Streptococcal Sore Throat, 352
- Sand Crab. (See *Emerita pacifica*.)
- São Paulo, University, Sociedade Brasileira de Geologia, 140
- Sarcoma Virus, Age Factor in Adaptability to Other Animal Species, 748
- Scales of Measurement, Theory, 677
- *Science*, New Editorial Policy, 1
  - Reduction in Size Due to Paper Shortage, 621
- *Science Illustrated*, First Issue, 481
- Science in Albuquerque High School, 467
  - Biarritz American University Section, 129
  - Basic, Regional Research Stations, 403
  - Democracy, 65
  - Exhibition, AAAS 1945 Meeting, 273; 367
  - Future, 415
  - High School, 149; 317
  - Industry, Museum, 342

- Science Legislation
  - Atomic Energy, Domestic Control, 133
  - Bills: Compromise for National Science Foundation, 192
    - H.R. 6448, 687
    - H.R. 6448, Why the Better Bill, 724
    - Kilgore-Magnuson, 225
    - S. 1720, 39
    - S. 1720 vs. 1777, 161
    - S. 1777, 164
    - S. 1850, Final Senate Bill, 270
    - S. 1850: On Floor of the Senate, 382
    - S. 1850 and the Senate, 589
    - S. 1850, United Front for, 727
    - S. 1850, Why the Better Bill, 724
    - S. 1850, Why in Favor, 725
    - S. 1850, Statement by Committee Supporting Bush Report, 558
  - Bush Report, Statement on S. 1850 by Committee Supporting, 558
  - Forum, 724
  - Holiday Recess and, 10
  - National Science Foundation, Committee for, 45
    - Practical Reality or a Perpetual Controversy? 104
    - S. 1850, Final Senate Bill, 270
    - Statement by Senator Willis, Introducing Bill for, 163
  - Notes on Science Legislation, 160
  - Pittsburgh Physical Society, Report on Science Legislation, 383
  - Scientists Divided, 688
  - Selective Service and Student Personnel, 479
  - Senate and S. 1850, 589
  - Training, Scientific, 70
- Science and Government Subsidies, 761
  - Facts, Feelings and Freedom, 760
  - Life in the World, and: George Westinghouse Educational Foundation Forum, 16–18 May, 662
  - Mankind's Plight, 569
  - Man's Dilemma, 241; 404
  - Matter With, 176
  - Means to What End, 403
  - Safeguarding in the National Science Foundation, 430
  - Soviet Union, Freedom, 281
  - Teacher and Legislative Proposals for Promotion of Science, 68
  - Teaching, Dangerous Postwar Development, 734
  - Training, Recognition of High School, 458
  - Writers Annual Award, 136; 448
- Scientific Evidence, Testing Validity by Consultant Articles, 541
  - Independence in Russia, 656
  - Personnel, Advisory Committee, 437
  - Research. (Also see Research.)
  - Research, Federal Aid, Critique, 370
  - Research and National Welfare, 540
  - Research in Postwar Era, 125
  - Research, Support of, 543
  - Training, 70
  - Worker, National Science Foundation and, 4
- Scientists, Are They Irresponsible, 572
  - Divided, 688
  - Europe, Packages to, 599
  - Sources of Future, 457; 599
- Sections, Free-hand, Another Superior Pith, 695
- Selenium, Thyroid Adenomas in Rats Receiving, 762
- Sera. (See Anti-Rh.)
- Serodiagnosis of Amebiasis, 598
- Service, Universal Military, in Peacetime, 579
- Sesame Flower. (See *Sesamum indicum* L.)
- *Sesamum indicum* L., Genetical Studies, 280
- Sex Hormonal Action and Chemical Constitution, 221
- Sex Hormones, Effects on Copulatory Behavior of Senile White Rats, 749
- *Shigella dysenteriae* (Shiga) and *E. typhosa*, Detoxification by Acetylation of Soluble Antigens, 387
- Silencing Air-stirring Motors, 429
- Sintered Glass Disks, 21
- Slide Rule for Addition of Squares, 113
  - Circular, 488
- Slides, Cleaning Microscope, 456
- Social and Economic Sciences (Section K), Work for, 105
- Social Problems, Social, and Physical Thinking, 717

- Social Science
  - Atomic Fission, Equal Control by Social and Physical Scientists, 370
  - Peace, 25
  - Psychologists, New Opportunities and Responsibilities, 33
  - Psychology, Function, 280
- Sociedade Brasileira de Geologia, University of São Paulo, 140
- Sodium Salicylate in Rheumatic Fever, Hyaluronidase Inhibition, 686
  - Triple Acetate Salt, Relation between Size of Divalent Cation and Solubility, 420
- Soil Conservation Society of America, 449
- Soviet Union. (Also see Russia.)
  - Biology, 86
  - Freedom of Science, 281; 404
  - Medical Research Mission, I, II, 605; 637
  - Scientists, 402
- Spinach, Soil Nitrogen and Thrips Injury, 331
- Spirochetal Relapsing Fever, Brain Involvement as Cause of Relapse after Treatment, 422
- Sprue, Use of Synthetic *L. Casei* Factor in Treatment of, 108
- Squares, Slide Rule for Addition of, 113

Staining Cover-Glass Preparations, New Glass Device, 23
  Plasmodia, 630
"Standard to Which the Wise and Honest Can Repair," Is There, 377

Statistics
  Recent Contributions to Theory of Random Functions, 283
Steric Effect in Organic Chemistry, 385
Sterility in Growing Rats on a Tryptophane-deficient Diet, 137
Streptamine and Streptidine Structure, and Degradation of Streptomycin, 53; 540
Streptidine and Streptamine Structure, and Degradation of Streptomycin, 53; 540
Streptococcal, Hemolytic, Sore Throat, Treatment With Penicillin, Sulfadiazine, and Salicylates, 352
Streptomycin, Absorption and Excretion in Dogs, 364
  Body Fluids, Estimation, 56
  Degradation, and Structure of Streptidine and Streptamine, 53; 540
  Interference with Antibacterial Action by Reducing Agents, 399
  Syphilis, Activity in Experimental, 365
  Toxicity for Man, 355
Student Personnel, and Selective Service, 479
Subaqueous Mud Cracks Formed by Settling, 85
Subtilin, Physical and Biologic Properties, 419
Sulfadiazine, and Hemolytic Streptococcal Sore Throat, 352
2-Sulfanilamido-5-carboxythiazole, Intestinal Antiseptic, 719
Sulfides and Amines, B-Chloroethyl, Biological Actions and Therapeutic Applications, 409, 436
Sulfonamides and Penicillin, Determining Bacterial Resistance and Susceptibility, 454
Sun Oil Company Plant to Produce Carbon 13, 82
Sunspot Group, Apparent Visible Violet Radiation in Recent Large, 681
Sweet-potato, Ratio of Carotene to Carotenoid Pigments, 193
Syphilis Antigen, Chemical Nature, 455
Syphilis, Experimental, and Streptomycin, 365

T

TDE (See 1,1-Dichloro-2,2-bis (p-chlorophenyl) ethane).
Tap-water Aerator, Semi-continuous, 75
Taxonomy, Why Ill-supported, 713
Teaching, Science, Dangerous Postwar Development, 734
Temperature, Effect on Susceptibility of Mouse to Poliomyelitis Virus, 137
Tergitol-7, Useful Selective Bactericidal Property, 758
Tetanal Toxin, Isolation and Crystallization, 615
Texas, University of, Defense Research Laboratory, 711
Thermodynamics Research Laboratory, University of Pennsylvania, 560
Thiamine Deficiency in Uterine Cancer and Menorrhagia, 441
  Depletion of Human Subjects on a Diet Rich in Thiamine, 198
Thiourea, Comparative Toxicity to Four Mutants of *Drosophila melanogaster*, 649
Thrips Injury to Spinach and Soil Nitrogen, 331
Thromboplastic Studies on Hemophilia, 402
Thunder, Rumbling, 26; 632
Thyroid Adenomas in Rats Receiving Selenium, 762
Thyroid Gland, Mechanism of Therapeutic Effect of Iodine, 421
Tobacco Seedlings, "Frenching" Response to Isoleucine, 329
Tocopherol, A-, Antipurpuric Action, 762
Tocopherols in Preventing Gastric Ulcers in Rats, 586
Tomato, Fusarium Wilt, 707
Toxicity of Streptomycin for Man, 355
Toxin, Tetanal, Isolation and Crystallization, 615
  Type A, *Clostridium botulinum*, Purification and Crystallization, 613
Tributyl Phosphate as Solvent for 2,4-Dichlorophenoxyacetic Acid and Similar Substances, 476
Trophoblast, Growth in Anterior Chamber of Eye of Rabbit, 25
Tropical Marine Laboratory, Functions and Development, 609
  Research Center, Iowa State College, 139
Tryptophane-deficient Diet and Sterility in Rats, 137
Tyndall, John, Observations on Penicillin, 1876, 232

U

Ulcer, Anti-. (See Anti-Ulcer.)
Ulcers, Gastric, in Rats, and Effect of Tocopherols, 586
Ultraviolet Light in Tracing Course of Drug Through the Body, 340
Uniform Luminescent Materials, 155
United States
  Civil Service Commission, Advisory Committee on Scientific Personnel, 437
  Navy Hydrographic Office, Division of Oceanography, 528
  State Department Report on International Control of Atomic Energy (Acheson Report), 451
Ureteral Kinetics in Situ, Photographic Method for Recording, 55
USSR. (See Soviet Union.)

V

Vacuum Desiccators, Opening "Frozen," 26
Valve, Low-resistance, and Indicating Flowmeter for Respiratory Measurements, 537
Vegetable Extracts, Inhibition of Oxidation of Ascorbic Acid by, 201
Veterans' Retraining Program in Geology, 177
Virus, Rheumatic, Direct Culture, 620
Virus, Sarcoma, Age Factor in Adaptability to Other Animal Species, 748
Viruses, Molecular Weights and Other Properties Determined by Light Absorption, 306
Vitamin A Carotenoids in Fowl, Apparent Antagonism, 584
  Coloration of Acid Earths, 175
  Rediscovery, 281; 404
  Reserves of Offspring Affected by Prepartum Diet of Cow, 616
  Substances, Synthesis of Biologically Active, 581
Vitamin E. (See A-Tocopherol.)
Vivax Malaria of Pacific Origin Naturally Induced, Relapses Following Delayed Treatment, 391

W

War, Impact on Medicine, 575
  On Weeds, 465; 492
Warburg Manometric Apparatus, Transparent Plastic Tank and Cover for, 144
Washington, State College, Institute of Technology and Institute of Agricultural Sciences, 141
Water Baths, Water-level Regulator, 401
  Loss from Respiratory Tract in Sub-tropics, 281
Water-level Regulator for Series of High-temperature Water Baths, 401
Weed Seeds, Treatment of Muck and Manure With 2,4-Dichlorophenoxyacetic Acid to Inhibit Germination, 476
  War on, 465, 492
Wells, Deep, Temperature in and Ice Age, 541
Westinghouse, George, Educational Foundation Forum, 16–18 May, 662
  Science Writing Awards, 136, 448
Wetting Agents in Histological Fixatives, 731
Willis, Statement by Senator Raymond E., Introducing Bill for National Science Foundation, 163
Wilt, Fusarium, in Tomato, 707

X

X-ray Crystallographic Data on DDT, 25

Y

Yale University, Agricultural Science Program, 623

Z

Zinc Salts and Inactivation of Penicillin, 629
Zoological Nomenclature, International Commission, 655

SCIENCE

Vol. 103, No. 2662 Friday, January 4, 1946

Editorial

GREETINGS FOR THE NEW YEAR from the new staff of *Science!* This, our first issue, comes to you as *Science* enters upon its sixty-fourth consecutive year. For 1946 we are therefore bringing you not a new magazine, but a very old one dedicated to providing you with a weekly cross-section of science in the making.

You will notice that the familiar advertisement on the front cover has disappeared. Cover space will be used henceforth to direct your attention to the more significant and newsworthy features of each issue. This was a step taken by the Editorial Staff and the *Science* Policy Committee only after weighing the consequences as realistically as they could be determined. Four advertisers have held the front cover position for four decades. Their support, week in and week out, has been no small factor in keeping *Science* solvent. Their continuation in other, less favored positions in this and later issues speaks for their devotion to our common cause.

With this issue *Science* also becomes a covered journal—the covers are of somewhat heavier, tougher stock than the text pages—an obvious advantage in the preservation of back numbers. Also, for convenience in handling and in filing, the magazine is trimmed. For the sake of the record an entire page will be regularly devoted to an enlarged Table of Contents which will be found each week in a regular position; we think it is space well spent.

The space occupied by this editorial will hereafter be devoted to an article of three or four thousand words in length, treating some significant, newsworthy development in the larger scientific field, or presenting in an understandable vocabulary an issue, a finding, or a summary in some field significant to us all.

Usually, this longer leading article will be followed by a series of four or more shorter contributions which will many times be addressed to a more restricted audience than can be encompassed in the entire membership of the Association. We have chosen to label this section "Technical Papers," rather than "Special Articles," as it has been called in the past.

Most of the special areas of inquiry have somehow managed to support a medium of publication. *Science* sees one of its more important functions, not in competing with these technical publications but in supplementing them and offering a service to those newly opened fields which border on each other and are usually designated by hyphenated titles.

In "Technical Papers" we shall try to discourage a content and a style which appeal only to the specialist. We shall give high preference to those papers that give evidence of a cooperative attack on some problem common to several specialties.

The overall editorial policy remains the same as it has been in the past —to try to present in as concise a form as is possible outstanding events of significance to all scientists, with an emphasis on those items that are of current interest. *Science* offers a quick mode of announcing scientific discoveries, appearing, as it does, fifty-two times a year. It does not, and cannot, operate with the speed of nonscientific journals, but compared to the usual scientific media which have publication lags of six to eighteen months, it offers unusually prompt service.

Men of science are not always men of letters! In providing for the editorial supervision of *Science*, the Executive Committee of the Association had in mind a distinct service to the officers of the Association who have manuscripts in preparation for delivery to sections and for subsequent publication. Wisely, the Executive Committee refused to bind the Editor's hands, so that *Science* is not *required* to publish all official addresses. The Executive Committee, the *Science* Policy Committee, the Editorial Staff, and the Editorial Advisers hope that every sectional address will be significant enough, broad enough, cogent enough to be printed in these columns. To that end the Editorial Staff offers its service to prospective authors. It hopes that authors will enter into preliminary correspondence and inform the staff of the title, the treatment, and the preliminary content of these papers. Let us help where we can.

Several new features will be introduced during January. One of them begins today—a section called "Letters to the Editor." The letters will usually be short comments on happenings of interest in the world of science, or the presentation of critical comments on some of our more controversial articles. Here we expect to provide an outlet for news, notes, comments, and controversy which do not warrant longer papers but are too important to be completely overlooked. We invite you to make use of this section.

Another editorial division, which will be used as often as the occasion demands, will be called "Science Legislation." Here we will abstract bills pending in the House or the Senate which bear on any phase of science. In this work, as in all other phases of our operations, we keep in close touch with Dr. Howard A. Meyerhoff, Executive Secretary of the Association, whose contacts on Capitol Hill have resulted in positive advantages to the whole of our Nation's scientific activity. Our readers are asked to keep us informed of pertinent local legislation in their areas.

Another development which will be reflected in future issues is an expanded and more comprehensive Book Review Section. We hope to provide numerous short reviews covering a wide variety of subjects. Here the Editorial Staff needs the cooperation of authors, publishers, and reviewers, if this section is to be an effective part of *Science*. A preliminary inquiry to publishers has already brought an encouraging response. From authors and publishers alike we have definite need of concrete suggestions for responsible reviewers of these publications. In time we would like to build a file of persons in all fields who are competent to review technical books and who will write the reviews promptly. The Editorial Staff invites those who would be willing to prepare reviews in specialized areas to write to the Editor, naming the fields in which they are competent to review new books. This invitation is especially directed to the younger scientific workers. By taking advantage of it, these people can render a distinct service to all scientists who read these columns.

In conducting the Book Review Section we are working in close collaboration with the Editor of *The Scientific Monthly*, to the end that there shall be no duplication of reviews in the future. We intend to continue the tradition that *The Scientific Monthly* will review the more popular books while *Science* will confine its attention to those of a more technical nature.

In addition to reviewing current books, we have laid plans to conduct a "Scientific Book Register," listing by title all significant new books in science as they appear. To this end the cooperation of the technical book section of the Library of Congress has been secured, as well as that of the publishers of scientific books. In the beginning the Register will appear biweekly, and since book production is seasonal, it will not be of the same magnitude in each issue.

Another related service will alternate with the "Scientific Book Register." Industry and laboratory supply houses constantly produce catalogues and brochures which come to the Editorial Office in large numbers. Many of these are indispensable to scientific workers in that they often provide a key to some research problem wholly aside from any objective the production of the catalogue might have had in the first place. We will call this section "Catalogue Corner." Later in the year we will sample the membership of the Association regarding its continuance.

Science does not develop wholly independent of the happenings in the world about it. Wholesale starvation brings an interest in nutrition; invasions of tropical beaches bring widespread interest in tropical hazards to the invader—and incidentally to mankind; a new explosive brings an interest in all forms of energy release; a "dust bowl," a dam, a comet, a Parícutin, bring other consequences in matters of reflection, deliberation, restructured values.

To these ends *Science* can contribute. It is our plan to introduce a series of *Special Issues* bearing on topics of signal importance as determined by the events of the day. No small part of these events are the opportunities afforded by the Association to gather at periodic intervals to hold exchanges of opinion and data, to give and to take. One such occasion is on our near horizon—the meeting in St. Louis—and to it we will devote a *special number* in anticipation and a *special number* in retrospect.

The attitude of the *Science* Policy Committee and the Editorial Staff is wholly experimental. We give you now the first issue of a New Year. It is a compromise containing some items that do not wholly please the Editorial Staff. Later issues will incorporate changes as we try first one experimental variable and then another. *Science* is being produced in the interests of the membership of the American Association for the Advancement of Science, its owners. Write to us! Let us know how you react to the changes you observe week by week.

A National Science Foundation and the Scientific Worker[1]

R. W. Gerard
University of Chicago

WITH THE ATOMIC BOMB, science came of age in our civilization. It will now have, and must exercise, the right to vote. One would not have chosen as the setting for our coming-out party "the rockets' red glare" and "bombs bursting in air," but such drama—and tragedy—was perhaps essential to stir both scientists and public to a realization of the penetration of science and technology throughout modern society—in peace far more than in war, for creation far more than for destruction.

Scientists have been slow in this country to fill their legitimate place in human affairs. Many men were content to pursue their private quest for knowledge and eschewed any responsibility beyond their towered walls. The historical tradition has lingered on—from the time when science was a dilettante interest of some wealthy individuals able to humor their personal whims or to patronize others who served as court scientists, like court magicians or jesters or musicians.

Only as certain tangible and useful results of these esoteric experiments reappeared time and again did science find its way into the universities and into the lower schools; did society begin to support experiments on a significant scale; did the scientist and technologist receive requests for aid from industry and agriculture and the military. But, in the mind of the expert as well as of the community, he was still doing only his particular job of research or application. He was still, in the telling figure of Carl Minor, "in the kitchen." He was still, as Raymond Swing recently pointed out, conspicuously absent from the invited consultants to the delegations at the San Francisco Conference or from those meeting in London to set up an international education office. "Not a single prophet of the century ahead of us was even asked to advise the men of state." Parenthetically, Compton, Shapley, and other scientists have now gone to London; and on 7 November Archibald MacLeish announced that the United Nations Educational and Cultural Organization has become the United Nations Educational, Scientific, and Cultural Organization.

All this was slowly changing for, as the Moe report puts it, "Science cannot live by and unto itself alone." Science was reaching social maturity. Its war contribution, through the Office of Scientific Research and Development and allied organizations, was impressive. Dr. Bush was close to President Roosevelt, and plans for a government research foundation began to incubate. How they would have fared in Congress on their own merit we will never know. As Dr. Bush wrote, "The Government has only begun to utilize science in the nation's welfare. . . . Science has been in the wings. It should be brought to the center of the stage."

Well, the atomic bomb brought it there and spotlighted it, and Congress is at last tumbling over itself with proposals to nourish the roots of discovery, as in the Magnuson and Kilgore bills, and to stifle its flowering, as in the May-Johnson bill. Science is in politics now and is in to stay. There will be changes that scientific workers will like and some that they will not like. I am convinced that the good will far outweigh the bad, but, even if the reverse were true, the road science is taking and is to take has long been inevitable (e.g. *Science*, 1942, **95**, 309). Recent events have accelerated movement, not changed direction.

Let me remind you of some of the changes within science. True laissez-faire research is almost unknown even now. Scientific workers are professionals and require some employer to pay for their living and to supply their facilities. In industry it is taken for granted, except in rare cases, that the technologist works on assigned problems. In universities and a few other institutions freedom of research is the slogan. But is it the fact? Research costs ever more money, and few institutions indeed have an adequate and fluid fund to support it. Investigators seek additional aid—from industry, from foundations, from private donors—and deliberately or without awareness they tend to shape their research to tap the available sources. When the Rockefeller Foundation becomes interested in research in psychiatry, so do many investigators; when the National Foundation for Infantile Paralysis has millions to spend, articles on nerve and muscle degeneration multiply; and the Bowman Committee warns, in connection with research grants, that we "need to guard against control of science by industry as well as against control of science by Government."

---

[1] Contributed to a panel discussion on "Research, Government, and You," sponsored by the American Association for the Advancement of Science and the Chicago branches of leading chemical organizations, 8 November 1945, Chicago, Illinois.

Further, with multiplying techniques and pyramiding knowledge, scientists have had to take refuge more and more in collaboration and team research. To ride the flood of literature, to master apparatus and methods based on far-flung branches of science, to turn out experimental findings at the ever-mounting tempo, the investigator needs help desperately. Abstracts, reviews, local bibliographers; secretaries, editorial assistants, draftsmen, photographers; machinists, glass blowers, animal caretakers; technicians and assistants; colleagues and collaborators—all these are needed to keep up with the Joneses in favored institutes. Quite aside from the war situation, what fraction of all our well-trained scientists is even now in a partly subordinated research position, as junior member of a team or lieutenant to a director?

Please do not misunderstand my not feeling too sad about this. I know as well as anyone the absolute indispensability of the imaginative insight and the freedom to exploit it. But I know also the ratio in time and effort between getting an idea and working it out. One first-rate creative scientist can keep dozens or hundreds of good men working at full effectiveness and maximum fertility, and, if human relationships are also fortunate, with complete personal satisfaction as well.

For all the pressure of immediate results, the sacrifice of personal research interests, the coordination from above, most scientists, I believe, were reasonably content in OSRD work, and many even under the additional strictures of work done directly with the armed forces. Science, like society itself, has become too large and too complex to remain completely individualistic.

The problems for the future are to find and to recognize true talent and leadership, to keep open the road to the top for all individuals possessing these qualities regardless of social status, and to maintain in scientists a greater concern for the good of the many than for selfish gain. These problems will become more pressing as more money, more power, and more prestige are attached to the scientific calling.

The present science bills, or any reasonable modification of them, will direct a great stream of financial support into the academic pools. In these bills emphasis is on basic rather than applied research, on aid to universities and like institutions rather than to industry or Government agencies—on recruiting young talent and subsidizing its full education. The amount of money under consideration is some fivefold the total annual expenditures made in the academic research field at the start of the war. Under this pressure many of the traditions and procedures which clothe the universities will burst their seams. Many unscholarly, aggressive entrepreneurs will be attracted by the odor of gravy.

If, however, the intent of the scientists who planned the National Science Foundation and of the legislators who are creating it is realized in the character of the administrative machinery, organization, and personnel, we may expect the inevitable readjustments to be salutary.[2] More, and more able, students will be recruited into science; but the cream of talent must not be skimmed from other areas of human enterprise, especially in the social sciences. More, and more desirable, research posts will open up to these students when their training is adequate; but relatively fewer will work on their own and at individual programs. Scientific discoveries will be increased in number and develop more rapidly; but the really great imaginative leaps in understanding will be of hardly greater frequency. The men and institutions and activities associated with research will be in the spotlight and under far greater social pressures and will have to make sacrifices to meet them. Perhaps, even, as Bernal suggested in his *Social function of science,* research teams will come to include publicists, promoters, lawyers, and other nonscientific members.

As science outgrows its cloistered walls and becomes a full-fledged participant in the hurly-burly of society, it must meet both responsibilities and opportunities. Scientists must be trained appropriately. They must learn in college, preferably as a part of a liberal education program, a minimum beyond their professional courses, including sufficient social science to cover the external relationships of science. They, or some of them, must learn the methods and skills of popular adult education. As the Moe Committee wrote, "It will not be sufficient, if science is to remain healthy in root and branch, merely to develop a large number of scientists and to provide them with the support necessary for their investigations. There is also the necessity of creating a better understanding of science in our national life, so that public approval and support for the future development of science will be forthcoming."

Scientific workers will find themselves forming more closely-knit and extensive groups, not primarily devoted to the exchange of technical knowledge. These groups, like the national American Association of Scientific Workers or the local Chicago Technical Societies Council, or, more and more, the American Association for the Advancement of Science itself, will be concerned with the interrelations of sciences, and especially with the external relations of science as a whole.

---

[2] This paper was written before the public statements of the Committee supporting the Bush Report. It was not intended as approval of any specific bill before Congress. My own belief is that several improvements are possible in drafting a final bill.

These groups will in time become action groups, attempting to influence public opinion and Government decisions in order to protect research from debasement and restriction and to extend the beneficial influence of research results and methods. After becoming strong and active, these groups will be in grave danger of forgetting their social obligations, of existing to serve the personal ends of their members and officers. This tragedy has happened often enough, in business, in labor, in agriculture, and even in the professions. If it should ever become the habit of scientists, I assure you, fellow scientific workers, we will be judged and treated accordingly by the society of which we are a part.

Alliance of Industry and Scientific Research in Great Britain

Basil J. A. Bard, Ph.D, B.Sc., Barrister-at-Law

Head of the Industrial Research Secretariat of the Federation of British Industries

THE LIFE AND WORK of the universities impinge upon the activities of industry in a variety of ways. New industrial products and processes frequently will be found to have germinated in the investigations carried out in the university research laboratories. Industry looks to the universities for provision of graduates for its technical, research, and, in some instances, high administrative positions. There are also indirect consequences of the dissemination of knowledge and culture from the centers of learning. These have their effect upon public and industrial opinion and national policy, which in turn may affect, by legislation or otherwise, industrial practice and progress.

In Britain since the end of the war there has been searching consideration of whether industry has been making its maximum contribution to the well-being of British universities and how it could benefit more fully from their activities. In the ensuing discussion, special attention has been devoted to scientific and industrial research.

There are many schemes now in hand in Britain for the expansion of pure and applied research in industry, cooperative research laboratories, and the universities. At the time of writing, however, many of the scientists, technicians, and research workers who have devoted their whole energies to World War II have not yet returned to their peacetime activities, and these have by no means reached fruition. This is an interim report, therefore, on some of the plans so far announced for a more intimate relationship between British industry and the universities with regard to scientific research. These plans are intended not only to assist in harnessing the work and results of universities to industrial needs without interfering with, or prejudicing in any way, the independence or integrity of the university spirit, but also to develop and maintain closer contacts between research workers in different environments.

The British universities, twelve in number, are renowned for the contribution they have made to the advancement and dissemination of learning. Few countries offer so rich a variety of facilities for access to the highest forms of education. In the sphere of science British universities have occupied themselves very considerably with investigations of a fundamental kind at the outer boundaries of man's knowledge of nature.

Although, in the long run, social and industrial advance is largely dependent on this extension of knowledge of the material universe, the whole spirit and atmosphere of university research is single-minded concern with the acquisition of knowledge for its own sake. The fundamental research carried out at the universities has fed and inspired the research undertaken in industrial laboratories, which has, in turn, irrigated the fields of industry. For instance, the first successful experiments in splitting the atom were carried out by Lord Rutherford at Manchester University and subsequently at the Cavendish Laboratories in Cambridge before World War I, and the theories then propounded by him on atomic structure have now been confirmed in practice by the atomic bomb.

Despite the fact that the universities are, rather naturally, a little remote from industry, there have grown up in the past a certain number of close contacts of great mutual benefit. For instance, collective research in the British glass industry is carried out in a special department of Sheffield University; at Leeds University a department deals with coal, coke, and gas research and another with textiles; at Birmingham will be found an experimental coal mine and oil-boring equipment. Furthermore, certain of the provincial universities contain technological departments serving the industries of the locality. There are also a number of recognized technical experts on university staffs who act as consultants to industry, and they and their laboratories, by bringing their experience to bear on industrial problems, have been of assistance in their solution.

Accounts now being given of the great scientific achievements of World War II show that a good deal of the fundamental work on which these were based and, during the last three or four years much of the applied work also, has been carried out in the laboratories of the universities. For instance, research on radar was undertaken at Bristol, at Birmingham (where the first magnetron valve was designed), at Cambridge, and at Nottingham Universities.

Recent reports of the Association of Scientific Workers and the Association of University Teachers have attempted to define the proper place of industrial research in the universities. Both organizations agree that departments of applied science should be fostered at the universities, but that in the normal way industrial development work should be carried out elsewhere. They believe that the war, as well as making abundantly clear the close connection between pure and applied research, has revealed the inadequacy of the intercourse between academic scientists and their industrial colleagues. They recommend closer contact and collaboration between industrial, governmental, and university laboratories and, where practicable, interchange of members of research staffs.

The endowments now being offered to universities by industry, in addition to being of great assistance to the work of the universities, contain within themselves an element of enlightened self-interest. One of the most important of these is the offer by the directors of Imperial Chemical Industries of eighty senior fellowships averaging 600 pounds a year each to universities in Britain (twelve each to Oxford, Cambridge, and London; eight each to Glasgow, Edinburgh, Manchester, Birmingham, and Liverpool; and four to Durham), to strengthen scientific research in physics, chemistry, and applied sciences, such as metallurgy and engineering. The administration of the scheme, which will operate for an initial period of seven years, rests wholly with the universities, which will select and appoint the fellows.

Birmingham University, in the center of the nonferrous metals and light engineering industries, has received an offer from Messrs. Joseph Lucas (motor and electrical equipment engineers) to endow two-year postgraduate courses in production engineering at a cost of 112,000 pounds, and a further 10,000 pounds has been offered to grant bursaries to needy engineering students. The University is considering also the establishment of industrial metallurgy laboratories, including a special chair of industrial metallurgy, to be endowed by sections of the nonferrous metals industry.

Most famous of the British cooperative industrial research laboratories, the Shirley Institute, which covers cotton, rayon, and silk textiles, has just announced that it is offering scholarships and fellowships at British universities to train in fundamental research methods young science graduates who subsequently will attain managerial positions in cotton mills.

Two illustrations of the practical way in which industry is attempting to overcome the serious shortage of chemical engineers revealed during the war years are the offer by the Shell group of oil companies to endow Cambridge University with 420,400 pounds to establish a school of chemical engineering, and the benefaction from the firm of Courtaulds to the Department of Chemical Technology of the Imperial College of Science, London, calculated to yield an income of 3,000 pounds a year in perpetuity, which will cover, among other needs, the establishment of a new chair of chemical engineering.

In order to ensure a more efficient and frequent interchange of scientific workers between industry and the universities, the London Midland and Scottish Railway Company (one of Britain's four main-line railways) has proposed, after consultation with the University Committee of Vice-Chancellors, that members of its research staff be appointed each year to do fundamental research in the university laboratories. It is hoped that the universities will invite these temporary workers in their laboratories to occupy part of their time in teaching. The universities, in turn, will be invited to send members of their staffs to work in the London Midland and Scottish Railway research laboratory at Derby, for agreed periods of about six months or a year, on applied aspects of fundamental problems in which they happen to be interested. These individuals would enjoy access to all the departments of the railway and would thus have the opportunity of seeing how the results of research are applied in large-scale railway development. The Railway Company's research laboratory is staffed by seventy university graduates and has sections dealing with engineering, metallurgy, chemistry, physics, paints, and textiles.

The Company is prepared to bear the bulk of the cost of this scheme, including the salaries and adequate allowances of both the railway and university research workers involved in the interchange. The Company hopes that the scheme will operate flexibly and on a multilateral basis rather than on a system of what might be termed "barter"; for example, one of the railway men might be sent to the engineering research staff at Cambridge, while the railway itself took a man working in that field from an institution such as Glasgow or Manchester University.

Significant among recent developments is the establishment of the Manchester Joint Research Council. This Council, sponsored jointly by Manchester University and the Manchester Chamber of Commerce, will assist in securing the effective application of the results of scientific research in industry, particularly in the northwestern part of England, where cotton and heavy engineering are the most important industries. An information service has been created which aims not so much at furnishing scientific answers to the problems submitted but at placing the inquirer in touch with the organization best able to deal with the particular subject. Regular meetings of the Council are now held in the Manchester area, and the scientists and the facilities at Manchester University and Manchester College of Technology will be available, where appropriate, to industrial firms in the region. A similar scheme is now being instituted at Leeds.

Finally, university research into the functioning of financial and business institutions in Britain and elsewhere, and the economic conditions affecting them, is being encouraged by the fellowships and grants awarded by the Houblon Norman Fund, sponsored by the Bank of England.

It will have been observed that, in the development of these links between the universities and industry, there is no suggestion that the former should sacrifice their academic integrity, or be guided as to policy by industry, or, except in special circumstances, should put themselves at the disposal of industrial organizations. It cannot be doubted that in the long run the national well-being will be served by these schemes, and others which, no doubt, will follow, for interknitting more closely knowledge and manufacture.

Wartime Research in Malaria

The Board for the Coordination of Malarial Studies

AN EXTENSIVE PROGRAM of research in the chemotherapy of malaria has been developed during the last four years through the efforts of a large group of university investigators sponsored and supported by the Committee on Medical Research of the Office of Scientific Research and Development. This program, integrated with that of cooperating industrial firms, is closely coordinated with malarial investigations in the Army, Navy, and U. S. Public Health Service through the Board for the Coordination of Malarial Studies. The functions of the Board are administered through facilities of the National Research Council provided by a contract between the National Academy of Sciences and the OSRD.

Useful knowledge has been accumulated on the biology of various malarial parasites, on their biochemical requirements, and on their behavior in different hosts. Studies on immunity in the avian infections have yielded information on the cross-immunization which obtains with different species of parasites. The immune response of human subjects to malarial antigen has not shown promise, either in the prevention or modification of the disease or in the production of complement-fixing antibodies which might be useful in differentiating between a latent infection and a cure in *vivax* malaria.

The studies in the chemotherapy of malaria have involved the screening of over fourteen thousand compounds for various types of antimalarial activities in various avian infections, a study of the toxicology and pharmacology of many of these compounds in laboratory animals, and a study of the potentialities of about eighty in human malarias due to parasites of domestic and exotic origin. In the course of these investigations, the chemical and pharmaceutical industries have responded generously to requests for both small and large quantities of material for animal and clinical studies.

The net result of these investigations has been the discovery of antimalarial activity in compounds derived from a variety of structural types, and a clear definition of the problems involved in the suppression and cure of malaria. In addition, certain investigations have progressed to the point where the results have been of definite value in the treatment of malaria. The practical advances emanating from the program can be summarized in brief as follows:

(1) *The development of better methods for the use of quinacrine (atabrine) in the suppression and treatment of malaria, which led to the demonstration that this compound is superior to quinine.*[1] The development of an accurate specific method for the determination of the small amounts of quinacrine in plasma permitted the collection of information on the pharmacology of this drug in experimental animals and man, upon which was based a rational usage of the drug.

(2) *The development of compounds superior to quinacrine.* Among these are several members of the 4-aminoquinoline series. In this group, SN 7618,[2] *7-chloro-4-(4-diethylamino-1-methylbutylamino)quino-*

---

[1] Statement of the Board for the Coordination of Malarial Studies. *J. Amer. med. Ass.*, 1944, 125, 977.

[2] The Survey number, designated SN, identifies a drug in the records of the Survey of Antimalarial Drugs.

line, has received the most extensive exploration, both in civilian and military establishments. This compound is an effective suppressive, when administered no more frequently than once weekly in a well-tolerated dose. It will also cause an abrupt termination of the clinical attack of *vivax* malaria and will cure *falciparum* malaria when administered for only one or two days. In addition, it does not discolor the skin as does quinacrine, nor does it give the disagreeable gastrointestinal symptoms which are sometimes seen with the administration of quinacrine. Several other compounds in this same chemical series would also appear to be superior to quinacrine. Promising compounds in other chemical groups are under study. However, investigations with compounds of the latter types have not reached the stage of field trial. It is therefore not possible to make any statement concerning their practical usefulness at this time.

(3) *The exploration of the 8-aminoquinolines.* During the past year the exploration of promising leads to suppressive drugs has been extended; however, the major emphasis has been focused upon the study of the 8-aminoquinolines with the hope of uncovering a nontoxic curative agent. This line of investigation received impetus from published reports of British investigators in the early 1930's on the prophylactic and curative actions of pamaquin (plasmochin) in *vivax* malaria. Clinical investigators under OSRD contracts reappraised these actions. They have now demonstrated a curative action of pamaquin in *vivax* malaria due to both domestic and Southwest Pacific strains of *P. vivax*. However, there would not appear to be a sufficient "spread" between the minimal effective and the maximal tolerated doses to warrant recommendation of its use at this time. Other 8-aminoquinolines are being explored with the hope of developing a compound with the curative action of pamaquin but without its concomitant toxicity.

PERSONNEL OF THE BOARD

R. F. Loeb, *Chairman;* F. A. Butler, Comdr. (MC), USN; W. M. Clark, Chairman, Panel on Biochemistry; G. R. Coatney, U. S. Public Health Service; L. T. Coggeshall, Capt. (MC), USNR; F. R. Dieuaide, Col. M. C., AUS; A. R. Dochez, OSRD; E. G. Hakansson, Capt. (MC), USN; E. K. Marshall, Jr., Chairman, Panel on Pharmacology; C. S. Marvel, Chairman, Panel on Synthesis; O. R. McCoy, Lt. Col., M. C., AUS; W. H. Sebrell, U. S. Public Health Service; J. A. Shannon, Chairman, Panel on Clinical Testing; and G. A. Carden, Jr., Executive Secretary.

Association Affairs

Recent Elections of Officers for Terms Beginning in 1946

President (one-year term): James B. Conant, Harvard University

Members of the Executive Committee (four-year terms): C. F. Kettering, General Motors Research Laboratories; Fernandus Payne, Indiana University

Members of the Council (four-year terms): H. R. Aldrich, Geological Society of America; W. M. Krogman, University of Chicago

Vice-Presidents of the Association and Chairmen of the Sections (one-year terms):

- Mathematics (A): R. E. Langer, University of Wisconsin
- Physics (B): L. A. DuBridge, Massachusetts Institute of Technology
- Chemistry (C): Henry Eyring, Princeton
- Astronomy (D): G. VanBiesbroeck, Yerkes Observatory
- Geology and Geography (E): John L. Rich, University of Cincinnati
- Zoological Sciences (F): Alfred E. Emerson, University of Chicago
- Botanical Sciences (G): E. C. Stakman, University Farm, St. Paul, Minnesota
- Anthropology (H): Leslie Spier, University of New Mexico
- Psychology (I): Sidney L. Pressey, Ohio State
- Social and Economic Sciences (K): Frederick C. Mills, Columbia University
- History and Philosophy of Science (L): Dorothy L. Stimson, Goucher College
- Engineering (M): Henry T. Heald, Illinois Institute of Technology
- Medical Sciences (N): Francis G. Blake, New Haven Hospital
- Agriculture (O): M. A. McCall, U. S. Bureau of Plant Industry
- Education (Q): Guy T. Buswell, Chicago

Science Legislation

Science Legislation and the Holiday Recess

Howard A. Meyerhoff
Executive Secretary, AAAS, Washington, D. C.

TWO PRE-HOLIDAY EVENTS have revealed both the President's and the Congress' interest in science legislation, but the avalanche of last-minute Congressional business relegated them to inside and inconspicuous places in the newspapers, and they may have escaped the attention of many scientists.

First in order of occurrence was the President's reply to the letter from Isaiah Bowman and his Committee supporting the Bush Report. The full text of the President's letter follows:

December 14, 1945

My dear Doctor Bowman:

Receipt is acknowledged of your letter dated November 24, 1945, on behalf of the newly organized Committee supporting the Bush report, regarding the science legislation now pending before the Congress.

I am keenly interested in the development of research and of the appropriate Federal assistance therefor. Brilliant results have been achieved by the scientists during the war. The people deserve these results in peace as well.

My views on the soundest form of Federal assistance have been stated both in my Message to Congress on September 6, 1945, and in the statements made by the Director of War Mobilization and Reconversion and the Director of the Budget.

These views were expressed after the fullest consideration of the best interests of all concerned, after consultation with scientists, with public administrators and with students of Government, after considering the Bush report and the committee reports on which it was based, and after weighing the views expressed in your letter which had previously been called to my attention.

I appreciate the interest taken in this subject by members of your Committee, and feel sure that their basic objectives of freedom of research, and non partisan administration of a program of aid to scientific research and education, will be attained under such an organization as I have recommended.

I am confident that I can count on them to support scientific research with the same zeal that has made our scientists so eminent.

Very sincerely,
(sgd) Harry S. Truman

Dr. Isaiah Bowman
President, Johns Hopkins University
Baltimore, Maryland.

The second event was the introduction into the Senate on 21 December of S. 1720, the science legislation after complete revision and redrafting. Sponsors of the newly drafted bill are Senators Kilgore, Johnson, Pepper, Fulbright, and Saltonstall.

The new bill has drawn heavily upon the testimony which was presented at the October hearings, as most scientists assumed and hoped it would. As it must, it translates the wishes of scientists into the practical terms of governmental procedure, and where it cannot accept certain proposals, it offers—or attempts to offer—workable compromises. The text of the 10-page bill will be issued in a subsequent number of *Science*, and therefore only a skeleton analysis of its main features will be given at this time.

The unique feature of S. 1720 is the establishment of a strong board to function coordinately with a single director-administrator. The latter will be appointed by the President, by and with the advice and consent of the Senate. Within the proposed Science Foundation there shall be divisions of (a) mathematical and physical sciences, (b) biological sciences, (c) social sciences, (d) health and medical sciences, (e) national defense, (f) engineering and technology, (g) scientific personnel and education, and (h) publications and information. Associated with each division is a "divisional scientific committee."

The National Science Board consists of nine "qualified" members appointed by the President for three-year terms, plus the chairmen of the several divisional committees. This Board may make recommendations directly to the President and the Congress, and the nine presidential appointees shall advise with the administrator in the appointment of the divisional committees. Members of the Board shall receive per diem compensation.

The bill provides for minimum percentage expenditures of 15 per cent each for national defense and health-medicine, and 25 per cent additional to be apportioned among the states for research and development.

While dedicating to the public patents, inventions, and discoveries growing out of federally financed research, the bill provides for retention of patent rights by contractors or inventors when "fair and equitable and consistent with the national interest" and provided there has been substantial private contribution to the cost. Remaining sections provide for international cooperation, interdepartmental coordination, fellowships and scholarships, and a register of scientific and technical personnel.

This, in brief, is the bill to which attention should now be directed. It will completely supersede S. 1297 (the Kilgore bill), but Senator Magnuson is not committed. Whether he will attempt to get S. 1285 out of committee in response to the strong lobby started by the Committee supporting the Bush Report is not predictable. S. 1720 is a serious endeavor to meet the demand of the majority of the scientists by setting up a board of qualified men and by making this board a check and balance to the administrator, without nullifying the latter's responsibility to the President and the Congress. The chief patent issue is reasonably met without sacrificing the aim to bring some system to patent policy within Government laboratories.. It compromises with the House and with the Military on the administration of the Division of National Defense, and it follows the wishes of the majority of scientists by including the social sciences.

It was in the conviction that the bill does combine the best features of the original legislation, and that it makes use of the best and most workable recommendations contributed by scientists at the October hearings, that Senators Fulbright and Saltonstall have joined in sponsoring the new bill. The latter is in committee and has been issued in the Preliminary Report (Subcommittee on War Mobilization Report No. 7, 21 December 1945) in order that scientists may study S. 1720 and comment before it is reported out of committee. The full text of the bill will be published in the next issue of *Science*.

The Committee for a National Science Foundation, formed at the invitation of Dr. Harold C. Urey and Dr. Harlow Shapley, and now located in the Hotel Astor, New York City, has issued a statement dated 28 December, 1945. It is addressed to Senators Kilgore, Magnuson, Johnson (Colo.), Pepper, Fulbright and Saltonstall. Its signers include Albert Einstein, Enrico J. Fermi, George R. Minot, Otto Meyerhof, J. Robert Oppenheimer, Harold C. Urey, Harlow Shapley and some 200 others. The text follows:

Knowledge secured by research has achieved public recognition as the necessary foundation of sound programs for national welfare, health, security and world order. It is clear that the magnitude of the research task which must be accomplished promptly in the interest of the nation and of civilization requires expenditures so great that government aid is required. The extensive public hearings just completed in Washington under the joint chairmanship of Senators Kilgore and Magnuson collected testimony from all sides which emphasized this point. Because it is believed that the public may be in doubt concerning the views of research men on the feasibility and practicality of scientific advance under government auspices, the following statements are made in the conviction that they are supported by the judgment of a majority of scientists:

1. Federal support of research must supplement funds for scientific inquiry from private philanthropic and business sources if science is to make its essential contribution to the welfare and security of mankind in the difficult years ahead.

2. The freedom of inquiry upon which science is dependent can and must be guaranteed for research under government no less than private auspices.

3. The government should support research in all fields of fundamental scientific inquiry relevant to national interest without arbitrary exclusion of any area.

4. Scientific findings resulting from Federally financed research activities should receive publication and should be dedicated to the walfare of the public.

5. The training of research personnel through national scholarships and fellowships for undergraduate and graduate study should be open to all on the basis of ability and scholastic achievement, and should be available for work in any qualified institution in any recognized field of science.

6. Although there is a serious division of opinion on the question whether administrative responsibility should be given to a governing board or to a single administrator, it should be possible to devise a plan of organization which will meet the major objections to either alternative.

These six points are in harmony with that part of President Truman's message of Sept. 6 to the Congress which urged the early establishment of a Federal agency to promote and support scientific research and aid to training of research personnel. An analysis of the testimony presented at the Senate hearings under the joint chairmanship of Senator Kilgore and Senator Magnuson on pending science bills indicates that there is sufficient agreement on these points to justify their utilization as a basis of legislation drafting.

The signers of this statement have a profound conviction that a program of Federal aid to research is vital to the national interest and that legislation acceptable if not wholly satisfactory to those who hold divergent points of view about particular questions of function and organization can be drafted. We stand ready to cooperate in the revision of the bills recently considered at the Senate hearings on pending national science legislation. Our purpose is to serve the national interest by securing the collaboration of the maximum number of qualified scientists in a united attack on the scientific problems confronting the nation.

A complete list of the signers will appear in the issue of 11 January 1946.

Technical Papers

The Lipotropic Properties of Inositol

C. H. Best, C. C. Lucas, J. M. Patterson, and J. H. Ridout

Banting and Best Department of Medical Research
University of Toronto

In the original report (*2*) of the discovery of the lipotropic effect of inositol and in subsequent publications (*3, 4, 7*) it was claimed that inositol exerts a specific effect upon the so-called "biotin fatty liver," which was believed to be the same as that produced by a beef-liver fraction. This was particularly interesting, since the "biotin fatty liver," which was stated to be resistant to choline, was supposed to be characterized by a high content of cholesterol. Inositol was reported to be more effective than choline in reducing the level of cholesteryl esters in the lipides of "biotin fatty livers" and also in those resulting from the feeding of cholesterol (*7*).

Beveridge and Lucas (*1*), in this laboratory, found that under certain dietary conditions, however, inositol was not more, but distinctly less, active than choline in reducing cholesteryl esters in liver lipides. Further work (to be published shortly) has shown that under all the experimental conditions chosen (21 comparative experiments) choline was at least equally, and usually more, effective than inositol in reducing bound cholesterol. It was invariably more active in reducing total lipides. Similar results were obtained in rats fed on fat-free diets, on diets containing fat, and on diets containing fat and *cholesterol*. When biotin was injected, choline was distinctly more active in reducing total lipides and was at least as effective as inositol in reducing bound sterols. In the prolonged experiments choline was much more effective than inositol in lowering the cholesteryl esters whether or not biotin was given.

No evidence has been obtained in this laboratory to suggest that there is any difference between the fatty liver produced by biotin and that caused by a high fat diet. The ratio of bound sterol to glycerid is the same in the presence of biotin as in its absence. Groups of rats (usually about 12 animals on each diet) injected with biotin (5 γ daily) responded just as well to choline as did those not receiving biotin. The biotin and nonbiotin groups responded to about the same extent to administration of inositol, this response being less than that produced by an equal quantity of dietary choline. The combined effect of choline and inositol is equally pronounced whether biotin is present or absent. In a recent paper, McHenry (*5*) has retracted certain of his earlier statements concerning (a) the characteristics of the "biotin fatty liver" (*i.e.* its identity with that produced by feeding a certain liver fraction) and (b) the specific lipotropic properties of inositol on this "biotin fatty liver." Our experimental results, which confirm and extend McHenry's latest findings, lead us to advance further along this pathway and to conclude that there is no evidence that the "biotin fatty liver" exists as a unique phenomenon.

McHenry (*5*) has stated that "it is obvious that inositol is effective in preventing the fatty liver caused by the beef liver fraction, while choline is not." That the liver fraction contains choline[1] has been noted (*6*), but the fact seems to have been overlooked in explaining the apparently greater relative lipotropic effect of inositol than choline upon the fatty livers so produced. Addition of further choline had only a small effect, as might be expected. Addition of inositol produced the well-known synergistic lipotropic effect. McHenry (*5*) has stated that "the effect of a combination of choline and inositol is similar to that produced by the same amount of inositol alone." However, the inositol was *not alone* in his experiments, because the liver fraction which was fed contained large amounts of choline. It is obvious that the fatty liver produced by the liver fraction is somewhat resistant to choline, but McHenry's failure to mention the presence of choline in the liver extract has tended to overemphasize the role of inositol under these particular circumstances. It would be interesting to know the level of liver fat which would result from giving a choline-free liver fraction and to compare the relative effects of choline and inositol under such conditions. Experiments along these lines are at present being conducted.

We have conducted many experiments in which diets containing cholesterol were fed over periods from 3 to 16 weeks and have not noted any preferential effect of inositol in lowering either bound sterols or total lipides. In fact, the lipotropic effect of inositol, which was less than that of choline even in short-term "cholesterol" experiments, diminished in relation to that of choline as the experiments were prolonged. In contrast, little, if any, diminution in the choline effect was observed during 16 weeks.

---

[1] We are using a similar fraction, obtained from the same source, and by the ennea-iodide procedure have found 9 mg. per cc. of free choline and 24 mg. total choline. The latter figure has been confirmed by microbiological assay.

It may also be recorded here that inositol (30 mg. per day) has not, in our experience, been effective in preventing the occurrence of the hemorrhagic kidneys which develop in young rats on diets low in choline and methionine.

References

1. Beveridge, J. M. R., and Lucas, C. C. *J. biol. Chem.*, 1945, **157**, 311.
2. Gavin, E. G., and McHenry, E. W. *J. biol. Chem.*, 1941, **139**, 485.
3. Gavin, E. G., and McHenry, E. W. *J. biol. Chem.*, 1941, **141**, 619.
4. Gavin, E. G., Patterson, J. M., and McHenry, E. W. *J. biol. Chem.*, 1943, **148**, 275.
5. MacFarland, M. L., and McHenry, E. W. *J. biol. Chem.*, 1945, **159**, 605.
6. McHenry, E. W., and Gavin, E. G. *J. biol. Chem.*, 1940, **134**, 683.
7. McHenry, E. W., and Patterson, J. M. *Physiol. Rev.*, 1944, **24**, 128.

TDE, 1,1-Dichloro-2,2-bis(*p*-chlorophenyl)ethane, as an Anopheline Larvicide

Christian C. Deonier and Howard A. Jones
Bureau of Entomology and Plant Quarantine[1, 2]
U. S. Department of Agriculture

Compounds related to DDT, including those present in the technical product, have been tested for their toxicity to fourth instars of *Anopheles quadrimaculatus* Say. One of these compounds, 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethane,[3] hereinafter called TDE from the generic name "tetrachlorodiphenylethane," has been found to have a toxicity equal to, and in some forms of application greater than, that of DDT. Tests have been made to compare the toxicity of DDT and TDE when applied in acetone suspensions, dusts, and oil solutions. The methods used in testing acetone suspensions and dusts were those described by Deonier, *et al.* (*J. econ. Ent.*, 1945, **38**, 241–243).

Acetone suspensions. Tests comparing the initial kill of acetone suspensions of TDE and DDT are reported in Table 1. In this form the two compounds were not significantly different in effectiveness. TDE, however, is indicated to be better than DDT in its residual toxicity, as shown in Table 2.

In a comparison at 0.01 p.p.m., the average length of time required for complete knock-down of larvae was 0.81 hour for DDT and 1.166 hours for TDE.

Dusts. Table 3 shows that, when impregnated on talc and applied as a dust, TDE had a toxicity to *Anopheles quadrimaculatus* equal to, or greater than, that of DDT. In other tests TDE has shown some indication of being superior against culicine larvae.

TABLE 1

Comparative Toxicity of TDE and DDT in Acetone Suspensions to Fourth Instars of *Anopheles quadrimaculatus*
(20 larvae per test, 3 replications)

	Material	Mean mortality in:	
		24 hours	48 hours
	p.p.m.	%	%
TDE	0.0050	88.3	100.0
	.0033	68.3	98.3
	.0025	58.3	95.0
DDT	0.0050	83.3	96.6
	.0033	73.3	98.3
	.0025	55.0	81.6

TABLE 2

Comparative Stability of TDE and DDT When Applied in Acetone Suspensions at 0.01 p.p.m. Against Fourth Instars of *Anopheles quadrimaculatus*
(20 larvae per test, 3 replications)

Material	Time between treatment and introduction of larvae	Mean mortality in:	
		24 hours	48 hours
	Days	%	%
TDE	0	98.6	100.0
	2	93.3	100.0
	4	100.0	....
	7	93.3	98.3
	9	48.3	61.6
DDT	0	100.0	....
	2	55.0	75.0
	4	3.0	8.3

Fuel-oil solutions. One of the difficulties encountered in laboratory comparisons of DDT in oil solutions is that the toxicity of the oil may affect the results where it is used in appreciable quantities. The smallest amount of oil that can be accurately measured is toxic when applied to a beaker or a pan. A spray chamber has been constructed in which larvae in small containers are exposed to small amounts of atomized spray. By dispersing a small quantity of spray in the spray chamber, larvae can be exposed to sublethal dosages of DDT or other materials in solutions.

In a spray chamber (8 × 8 × 8 ft.), 0.4 ml. of No. 2 fuel oil containing 0.5 per cent of DDT gave an average mortality of 76.6 per cent in 48 hours in three containers exposed simultaneously. Paired tests of TDE used at the same dosage gave 100 per cent mortality in 24 hours.

In further tests against fourth instars of *Anopheles quadrimaculatus*, the mean mortality of 0.4 ml. of No. 2 fuel oil containing 0.5 per cent of DDT was 55.8 per cent after 24 hours and 69.1 per cent after 48 hours. Against the same larval population 0.2 ml. of No. 2 fuel oil containing 0.5 per cent of TDE gave

---

[1] This work was conducted under a transfer of funds, recommended by the Committee on Medical Research, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine.

[2] Acknowledgment is made to Sgt. Harry H. Incho for his valuable assistance in conducting the laboratory tests.

[3] The term "DDD" has been used for this compound, but the designation "TDE" seems preferable. The latter is used in order to avoid possible phonetic confusion with DDT and also because two proprietary products called DDD are on the market.

courses in the fields of physics, chemistry, physiology, mathematics, and medicine, to give a well-balanced basic medical physics background, and completion of a certain amount of original research in the laboratory.

In addition to the teaching functions, the division has an ambitious program of research outlined in the field of medical physics. For this purpose the 60-inch cyclotron and an RCA electron microscope are available in the group, together with the facilities of the Radiation Laboratory, the Physics Department, and the Medical School, both in Berkeley and San Francisco.

The University of Pennsylvania has created the new office of Director of Inter-American Activities and has appointed Dr. W. Rex Crawford to that post, it has been announced by Dr. George W. McClelland, president of the University.

Dr. Crawford, who will continue to serve also as professor of sociology at the University, recently returned to this country from Brazil, where he spent two years as cultural relations attaché at the American Embassy in Rio de Janeiro. In 1941 he was exchange professor at the University of Chile, in Santiago, under the provisions of the Buenos Aires Convention, and in 1942 he directed the Inter-American Training Center in Philadelphia for the Office of the Coordinator of Inter-American Affairs.

According to Dr. McClelland, the new directorship was established because of the University of Pennsylvania's long-continued interest in inter-American cultural relations, students from South America having been enrolled at the University as early as 1828.

An Institute of Atomic Research has been established at Iowa State College under the direction of Dr. Frank H. Spedding, professor of physical chemistry and director in charge of atomic research. The general purpose of the Institute will be to carry on investigations of possible application of atomic energy to the various fields of activity of the college: agriculture, engineering, science, veterinary medicine, and home economics. For the present, research also will be continued with certain other projects started during the war period. The work of the Institute will be closely correlated with the general research of the Division of Science under Dean H. V. Gaskill. Two new appointments have been made: Dr. L. Jackson Haslett, assistant professor of physics, began work on 1 January, and Dr. John F. Carlson, associate professor of physics, will join the staff on 1 April. Iowa State College will work in close cooperation with the University of Iowa, which is establishing an Institute of Nuclear Research.

The University of Rochester has established a neuropsychiatric clinic at the School of Medicine and Dentistry, which has been made possible through a gift of $2,153,954 from Mrs. Helen Rivas, of Leroy. This is in addition to the building fund for the new structure, the cost of which is tentatively estimated at about $600,000. Construction of the clinic is expected to start early in 1946, and it is hoped that the building will be completed within a year. It will face Crittenden Boulevard adjacent to Strong Memorial Hospital, and will be connected with the hospital by a corridor. It will be five stories high and will contain physical and occupational therapy and recreational facilities for patients, with ample laboratory space for research and investigation.

Ten American universities have been offered fellowship awards in a five-year program for postgraduate studies in food and nutrition financed by Standard Brands, Inc. The annual grants will be awarded to college graduates with high scholastic records who wish to continue their studies for postgraduate degrees in biochemistry, organic chemistry, microbiology, and chemical engineering. The universities to which the grant has been offered are: Cornell University in bacteriology; Harvard University, Indiana University, and Princeton University in organic chemistry; the Massachusetts Institute of Technology in chemical engineering, biology, or food technology; the University of Pittsburgh and the University of Wisconsin in biochemistry; and Rutgers University, Yale University, and Stanford University in microbiology. Selection of the fellows will be made by each university where the fellowship is awarded, entirely free from any influence by Standard Brands. Neither will there be any restrictions or specifications imposed on the students by the company.

Fundamental research benefits at Ohio State University through a grant of $100,000 from its Research Foundation. This sum, according to Dr. A. R. Olpin, secretary and executive director of the Foundation, represents a return to the University for the use of its facilities in governmental and industrial research. It is taken from the research reserve of the Foundation, accumulated through earnings from patent licensing and other sources. It is expected that all or most of it will be used in the creation of fellowships at the University. The fund will be allocated under the direction of President Bevis, with the concurrence of the director.

The University of Leeds has received a gift of 50,000 pounds from Charles Brotherton, president of the chemical engineering firm of Brotherton and Company, Yorkshire, to establish a laboratory in chemical engineering. In addition, Mr. Brotherton made an immediate gift of 5,000 pounds for the same purpose.

Turner and Newall, Ltd., London, have provided funds for eight research fellowships in engineering, inorganic chemistry or physics, or allied sciences, these fellowships to be financed by them for a period of seven years. The fellowships are to be established at specified universities in areas in which the company has certain of its larger factories and will be known as "Turner and Newall Research Fellowships." Manchester University will have four; the University of London, two; Leeds University, one; and the University of Durham, one. The fellowships will each be worth 600 pounds a year, and the universities will accordingly receive 33,600 pounds over the seven-year period.

The Museum of Science and Industry, Rockefeller Center, New York, has opened a Navy exhibition of weapons and war equipment, with a view to informing the public of naval research and development work during the war as well as pointing to the need for continuing a "research engineering program" in the postwar period. Among the exhibits are radar devices; radio-controlled bombs; rockets; jet-propelled, radio-guided missiles; proximity fuses; and a variety of other weapons, many of which are being viewed by the public for the first time. In addition to having an opportunity to operate certain of the equipment on display, visitors may have a radar-scope view of New York as it appears to a bombardier. The relationship of the various atomic units to each other is demonstrated by a three-dimensional figure of an atom of Uranium 235, magnified 279 billion times—a feature of the exhibit.

The First Inter-American Typhus Conference met in Mexico, D.F., 7–13 October 1945, at the invitation of the Secretaría de Salubridad y Asistencia of Mexico. The Institute of Inter-American Affairs and Pan-American Sanitary Bureau collaborated with the Secretaría de Salubridad y Asistencia in calling the Conference. Representatives from Central and South America and the Caribbean Area and from the United States, particularly delegates of the Armed Forces, met with the Mexican workers on typhus for a complete week of discussion of the distribution of rickettsiae in America; the isolation and classification of rickettsiae; the epidemiology of typhus; the diagnostic methods of rickettsiae; prophylaxis of typhus; clinical, hematological, and therapeutic phases of typhus; problems of nomenclature and the control of typhus during the present war and plans for its control in the postwar period.

The recent experience with the use of typhus vaccine and the utilization of DDT and other insecticides in the prophylaxis of typhus made the calling of the Conference a timely event.

The Metropolitan Section of the American Physical Society, at its meeting in New York on 9 November 1945, passed a Resolution calling for "the immediate removal of all restrictions on the publication of scientific information. . . . Any restriction of research will not only be contrary to the tradition of science but will delay the development of scientific research in this country. Advantages which may accrue from regimenting science for military secrecy will be more than offset in the long run by the disadvantages caused by hampered communications among scientists, the difficulties of training young scientists, and the general discouragement of scientific initiative."

A corollary of the first Resolution, not reproduced here, had as its objective the immediate removal of censorship on "scientific information." It called for the formation of a board, composed largely of scientists and engineers, charged with the responsibility of distinguishing between scientific information and detailed technologies. The Society does not oppose secret technologies.

The Society has taken the position that, in the interest of world peace and our national security, our Government should "take immediate steps through the existing framework of the United Nations Organization to call a conference for the purpose of working out machinery for international control of armaments, especially those involving atomic power," and recommends that "the United Nations Organization be encouraged to set up an international commission of scientists to advise on technics through which such control might be exercised."

The Tennessee Academy of Science passed the following Resolution at its fifty-fourth meeting at George Peabody College for Teachers, Nashville, Tennessee, on 1 December 1945:

That the Tennessee Academy of Science vote concurrence in the ideas expressed in the letter of 24 November 1945, addressed by Isaiah Bowman and others to the President of the United States, strongly favoring the Magnuson bill and opposing the Kilgore bill; and

That members of the Academy be urged to study the letter, and compare the bills, and write their Representatives and Senators in Congress concerning their judgments; and

That members of the Academy believe wise decisions as to sponsoring scientific research and training scientific personnel are vital to our Nation's future, and should be taken promptly, boldly, and without compromises that would make the programs of sponsorship weak and ineffective.

Henry B. Bryans, executive vice-president and director of the Philadelphia Electric Company, was unanimously re-elected to serve a third term as president of the American Standards Association. Frederick R. Lack, vice-president and manager of the Radio Division, Western Electric Company, Inc., was elected vice-president. The other officers of the American Standards Association announced at the Annual Meeting, held at the Hotel Biltmore, New York, on 7 December are: E. C. Crittenden, assistant director of the National Bureau of Standards, as chairman of the Standards Council, and L. F. Adams, General Electric Company, as vice-chairman.

Dr. W. Albert Noyes, Jr., chairman of the Department of Chemistry at the University of Rochester, has been elected president of the American Chemical Society for 1947. Colonel Bradley Dewey, president of the Dewey and Almy Chemical Company, Cambridge, Massachusetts, is to be president of the Society for 1946. Other officers have been announced as follows: Dr. Charles A. Thomas, director at large; Dr. Charles L. Parsons, director for the Fourth District; and Dr. Samuel C. Lind, director for the Sixth District.

W. A. Pennow and R. T. Burns, Westinghouse Electric Corporation engineers, have recently developed an indicator which utilizes a tri-colored beam of light to guide a pilot attempting a landing at night. The pilot of a plane approaching the landing strip from too steep an angle sees an amber beam projecting from the indicator located on the near end of the field. If the approach is too low, a red beam warns him away. The go-ahead signal is a beam of green light, between the amber and the red, which the pilot follows in until the wheels contact the ground.

The Corporation explains that the "night eyes" are provided by an optical system containing only five basic parts. Light from a 100-watt incandescent bulb is gathered and focused on a color filter, which splits up the white light into three bands—amber, green, and red. These bands are projected through a special double convex lens which focuses the rays into sharp beams. Between this lens and the color filter is located a shutter that opens and shuts 40 times per minute to give a blinking effect to the beam, thus making it more distinguishable to the pilot. The whole mechanism is contained in a housing the size and shape of a small searchlight.

The beam is visible, under all conditions except fog, for a distance of three miles, giving the pilot ample time to get his bearings and make any corrections in his approach angle. In addition, the indicator is equipped with a dial for adjusting the angle of the beam to fit the different landing speeds of planes. With ten possible adjustments available, the indicator can accommodate itself to the landing speed of every plane now flying. It should prove most valuable at small airports and for private planes, where cost of radar- or radio-directional equipment is prohibitive.

Meetings

The Third National Conference of the Sciences, Professions, Arts, and White Collar fields will be held in the Engineering Societies Building, 29 West 39th Street, New York, Friday, 11–12 January 1946. On the program for the first day is an informal reception and registration at 7:00 P.M., followed by a public session at 8:00 P.M. A series of panel discussions at 10:00 A.M. on Saturday will cover the topics: Full Utilization of the Sciences and Professions; International Cooperation; Full Employment Opportunities; Standards of Living. The findings of the Conference will be summarized at 2:30 P.M.

This is the Third Annual Conference arranged by the *National Council of Scientific, Professional, Art, and White Collar Organizations,* which maintains offices at 1860 Broadway, New York 23, N. Y. The officers of the organization are: Dr. Kirtley F. Mather, President, Miss Olive Van Horn, Secretary, Dr. Alex Novikoff, Treasurer, Evelyn Adler, Executive-Director, and Dr. Donald Dushane, Dr. Mordecai Johnson, Dr. Philip White, and Lewis Merrill, Vice-Presidents.

The American Sociological Society will hold its next meeting at the Hollenden Hotel, Cleveland, Ohio, on 1–3 March 1946.

The Crystallographic Society, organized at Harvard University and Massachusetts Institute of Technology in 1939, is planning to resume its activities which were suspended during the war. The Society concerns itself with the science of crystallography and its applications to such fields as Physics, Chemistry, Metallurgy, Ceramics, and Biology, and is not restricted to the classical phases of crystallography commonly associated with mineralogy.

In 1940 this Society initiated the idea of launching a *Journal of Crystallography.* More recently, several Societies have discussed plans to replace the *Zeitschrift für Kristallographie,* no longer being published. Since there is no other journal devoted exclusively to crystallography, the Society is taking an active interest in this new development.

A meeting is tentatively planned for 21–23 March 1946 at Smith College. Those wishing to present papers are requested to send titles and brief abstracts to Prof. M. J. Buerger, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

All those wishing to renew membership or to become members of the Society or who desire further information may write to William Parrish, Acting Secretary-Treasurer, The Crystallographic Society, Philips Laboratories, Inc., Box 39, Irvington, New York.

The American Association of Cereal Chemists will hold its 1946 annual meeting at the General Brock Hotel, Niagara Falls, Ontario, Canada. The meeting is scheduled for 13–16 May, with a preconvention registration taking place on Sunday, 12 May. Dr. Oscar Skovholt, Quality Bakers of America, is National President and will preside over the meeting. Members of the Association are urged to make their hotel reservations early. Excellent facilities are provided not only by the General Brock Hotel but also by the nearby Foxhead Inn, and by the Hotel Niagara, Niagara Falls, New York, which is within walking distance of the headquarters hotel.

Conditions Abroad

Dr. Jaroslav Drbohlav, former chief of the Division of Microbiology of the Czechoslovak State Institute of Health in Prague, Czechoslovakia, has communicated with Dr. Oscar Felsenfeld, chief research bacteriologist, Mount Sinai Medical Research Foundation of Chicago. Dr. Drbohlav is well known in America not only for his co-authorship of the first medium used for the cultivation of *E. histolytica,* but for his work at Harvard University and his studies of tularemia in Europe.

Dr. Drbohlav and his associates were cut off from the world during the six years of German occupation. Out of the six chiefs of the divisions of the State Institute of Health of Czechoslovakia, four were executed by the Germans, Drs. Drbohlav and Vaniček being the only survivors. The Institute, built with the aid of the Rockefeller Foundation, was operated by the Germans and used for the production of sera and vaccines. Dr. Drbohlav was expelled, but expects now to be reinstated. He states that the worst suffering has been "to be cut off from American and English scientific literature." He reports that the conditions in Czechoslovakia are bad. The country lacks food (mainly fats and proteins), tobacco, coffee, etc., and there is an urgent need for medicaments and materials for medical use.

Dr. Stefan Blachowski, acting president of the University of Poznań, and Polish editor for the *Psychological Abstracts,* writes to Dr. Walter S. Hunter, of Brown University, that he is where he can receive books and reprints and journals. Practically all of Dr. Blachowski's personal effects, as well as the Psychological Institute and the offices of the Polish *Psychological Quarterly,* have been destroyed. Plans are now being made to start publication of the latter journal, and work has already been begun at the University, which needs both books and apparatus.

Prof. Karol Starmach, of the Ichthyobiological Institute at Krakow, writes that after a sojourn at the German concentration camps of Dachau and Sachsenhausen he has returned to the Institute and his research on the bottom organisms of Polish rivers and streams.

Dr. Bernard E. Read, of the Henry Lester Institute for Medical Research, Shanghai, China, has recently returned to this country after two and one-half years' internment by the Japanese in Shanghai. He reports that the Institute has been returned to its Trustees with the majority of its equipment gone and all radiators and similar fittings removed. The library, however, is complete. Considerable time will be required before the Institute can function normally again. Dr. Read's present address is 18 South Buck Lane, Haverford, Pennsylvania.

Recent Deaths

Dr. Edwin W. Kemmerer, 70, retired Walker professor of international finance at Princeton University and financial adviser for fourteen governments during a period of thirty-one years, died 16 December 1945.

Major Sir Thomas Selby Lawson-Tancred, 75, British archeologist and author, died on 15 December 1945. The ninth baronet of his line, he served with the British Army in India and in the World War.

Dr. Roy Jay Holden, 75, geologist and member of the faculty of Virginia Polytechnic Institute for forty years, died on 16 December 1945 at his home on the campus.

R. D. Landrum, a widely known ceramist and a former president of the American Ceramic Society, died on 30 November 1945 in Cleveland, Ohio, after an extended illness. Mr. Landrum was 63 years of age. Mr. Landrum was associated with the Harshaw Chemical Company for a period of 21 years. In the period just prior to his death he was engaged in the sales development of synthetic optical crystals grown from fused salts, a rather recent Harshaw specialty.

Newton G. Evans, 71, professor of pathology and director of research at the College of Medical Evangelists, Los Angeles, died on 19 December 1945 after an extended illness.

Dr. Olin F. Tower, 73, professor emeritus of chemistry at Western Reserve University, died at his home in Mount Dora, Florida, on 21 December 1945.

Government Support for Research Associations in Great Britain[1]

Mr. Herbert Morrison, addressing the Conference of Industrial Research Associations on 6 November declared that we need research workers to-day as much as in 1940 and that the Government will do everything possible to encourage British industry to use scientific research. It is essential that some of the money gained to industry by relief from taxation in the new budget should be invested in research. Large concerns, he hoped, would establish or extend their own research departments, but smaller concerns should give their full support to existing research associations, for no single section of industry can do without this essential scientific partnership and remain virile. Moreover, Government support of industrial research must be backed by readiness to use its results, and firms which can not maintain fully equipped research staffs of their own should employ at least some trained scientific workers who can cooperate with the appropriate research association and help in the interpretation and application of its work.

Expenditure on research should be regarded as an essential cost and, dealing with the finances of research associations, Mr. Morrison said that with larger incomes the research associations would be able to carry out more of the expensive development work. The Government has therefore decided that in suitable cases it will make single grants to finance capital expenditure for such special purposes as buildings and re-equipment, the purchase of particularly expensive apparatus or the provision of semi-scale plant. Until a research association attains an appropriate scale, the present system of a block grant and an additional grant will continue. Eventually, the additional grant will cease, but a new block grant will be made, to continue indefinitely so long as the Department of Scientific and Industrial Research is satisfied with the activities of the association. The associations, Mr. Morrison said, can rely on the Government to proceed as rapidly as possible with the release and training of promising research workers, and all possible assistance will be given for rebuilding or extending laboratories. Sir Edward Appleton, referring to the importance of first-class research workers, pointed out that a monastic life is not stimulating to the young scientific worker, and there should be the closest contact between the research associations themselves, and with the universities and other research establishments.

---

[1] From *Nature.*

Dental Teaching and Research in Great Britain

It is reported in The Times, London, that dental teaching and research in Great Britain will be aided by grants from the Nuffield Foundation. One of the general aims of the trustees is to support research which promises to help people to be healthier. After promoting schemes for the advancement of child health and industrial health, they have, with Lord Nuffield's approval, turned their attention to dental health, an urgent question in view of the widespread incidence of dental disease.

On expert advice the assistance provided by the foundation is to be in three parts: First, grants amounting to 9,000 pounds a year for 10 years to four university dental schools to enable them to develop in various ways their research work on preventive dentistry; second, the provision of Nuffield Dental Fellowships designed to improve the supply of dental research workers and teachers; third, a few scholarships to enable dental students of outstanding ability to receive a more thorough scientific training.

The dental schools to which grants have been made are the Sutherland Dental School, University of Durham; the University of Leeds Dental School; the Turner Dental School of the University of Manchester and Guy's Hospital Dental School.

The Nuffield Dental Fellowships will be open to three groups of candidates—those with dental qualifications, university graduates in medicine, and thirdly, those holding a university science degree. Fellowship holders will be required to obtain such scientific or other training as may be necessary to qualify themselves to undertake teaching and fundamental research on dental health and disease.

Normally the annual value of a fellowship will be between 400 and 800 pounds. It may be awarded for one or more years, but as a rule for not longer than three years. Travelling expenses will be paid to fellows who go abroad for study.

The scholarships available for dental students are intended for candidates who, in the opinion of their dental school, would profit by receiving during their course of training additional instruction in anatomy and physiology. A scholarship will normally be tenable for only one year, but in suitable cases may be renewed for a second year. It will provide tuition fees and a subsistence allowance not exceeding 200 pounds a year.

In the Laboratory •

Black Fly Incubator-aerator Cabinet

Lyell J. Thomas
University of Michigan Biological Station and University of Illinois

The writer, in need of large numbers of parasite-free black flies, designed the cabinet described below. It has been in operation each summer for the past five years and has supplied all the black flies required for experimental and taxonomic use.

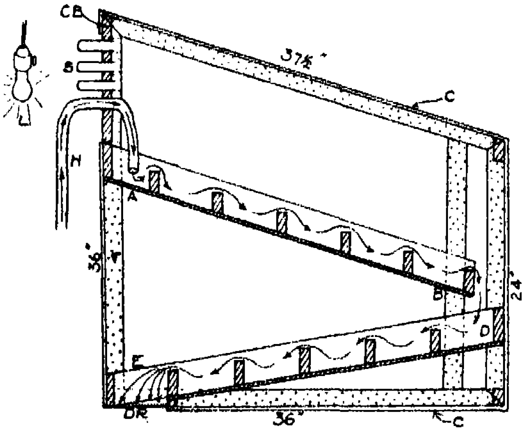


Fig. 1. Black fly incubator-aerator, side view cut away to show operation and construction of the interior.

The cabinet consists of a frame made of 1 × 2-in. pine lumber covered with heavy dark canvas. Cypress would probably be superior to pine for this purpose. The front of the frame is 36 in. high and 18 in. wide. Near the top, on the front side, is a compo-board, CB, 1 in. thick, bored to accommodate a dozen ¼ × 2½ in. shell vials, S. One of the holes is used for a hose connection, H, with a lake-water supply faucet. Inside the cabinet, just below the compo-board, is a wooden trough, AB, with sides 4 in. high and a bottom 16 in. wide. At intervals throughout the length of the trough, 3-in.-high baffles are arranged to make a series of pockets to form a riffle board. This trough is sloped to the back so that the water, when turned on, spills over into a similar riffle-board trough, DE, which in turn carries the water off to a drain, DR, in front. The drain is covered with fine-mesh, copper-wire screen to prevent any flies from escaping at this point. The canvas cover, C, is tacked on all but one side, where the flaps are buttoned or pinned. These flaps may be rolled back to allow easy access to the riffle boards from the side. The canvas on the bottom of the cabinet is tacked near the drain so that it is constantly soaked with water. The evaporation of the water up the sides of the cabinet serves as a method for cooling the interior.

Vegetation, covered with eggs, larvae, and pupae of black flies, is collected from a stream, brought back to the laboratory in minnow buckets half-filled with water from the stream, and placed in the shallow compartments formed by the baffles. The water in these buckets is then poured into the upper trough in order to save any larvae which detach from the vegetation while in transit. Within a day or two most of the larvae are attached to the baffles. The canvas side-flaps are closed tightly, and an electric light, L, is turned on in front of the vials in order to attract into them the emerging flies. The males appear first, followed later by the females. One filling of the troughs from a field collection will last for several weeks. Flies are collected in the vials daily. The effect of an abundant food supply on the flies will be noticed within a week or two, as these later-emerging flies are much larger than those caught in the wild.

Although the cabinet has been used primarily to collect black flies, it will work equally well with chironomids, caddis flies, and other rapids-inhabiting insects.

Sintered Glass Disks

Arthur D. Mack
Naval Medical Research Institute, Bethesda, Maryland

A method is described for the laboratory manufacture of sintered glass disks of various sizes and porosity. The disks include a glass ring which gives them increased strength, resistance to mechanical shock and easy removability for cleaning or replacing by a disk of another porosity. In this laboratory these disks have been used successfully in funnels in connection with rubber gaskets known as "double rubber cup washers" which are obtainable from any plumbing supply house. The details of this assembly are presented in the accompanying illustration.

To make the disks, a pyrex glass ring of the desired size is cut from glass tubing, placed on a galvanized iron plate and heaped to overflowing with powdered pyrex glass screened to a size which will give the desired porosity. The plate is then placed in a furnace (preferably muffle) at 975° C. for about eleven minutes and then removed and allowed to cool. Depending on the size of the furnace, the time may be varied by a minute or two, in order to produce proper adhesion of the pyrex granules to themselves and to the ring. The disk may be polished by rubbing against a flat glass plate with powdered glass as an abrasive.

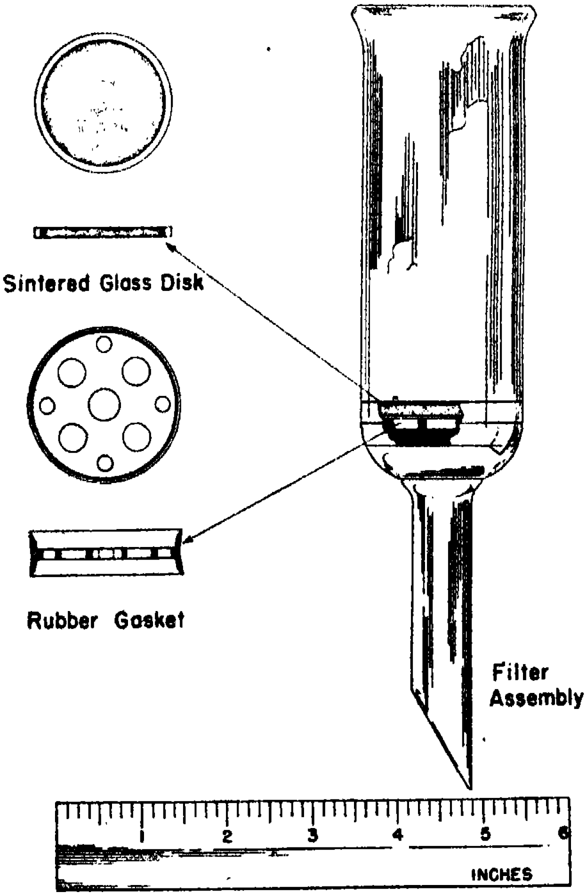


FIG. 1

Attachment of Electroencephalographic Electrodes

CHESTER W. DARROW and JULIAN H. PATHMAN
Institute for Juvenile Research, Chicago

A perpetual problem in electroencephalography has been to secure an expeditiously applied, electrically stable, comfortable, and readily removable attachment of electrodes to the scalp. After trying various methods, most workers return to the use of flattened solder pellets with electrode paste, attached to the scalp by collodion (F. A. and E. L. Gibbs. *Atlas of electroencephalography.* Cambridge, Mass.: L. A. Cummings, 1941). This method requires an air blast for drying the collodion. If electrode paste is rubbed into the scalp area to reduce skin resistance, the collodion does not adhere readily, and, once satisfactorily applied, is difficult to remove from the scalp and hair without the use of objectionable solvents.

The possibility that a more satisfactory material than collodion might retain the general advantages of the technic while eliminating its disadvantages led us to experiment with other adhesive materials. Having found a paraffin wax of low melting point (47° to 49° C.) very satisfactory and having used it ourselves for the past year, we wish to call the attention of others to its advantages.

After massaging a point on the scalp with a finger tip moistened with a commercial electrocardiograph paste, an electrode with a bit of paste is placed on the area, and it is painted over with melted paraffin by means of a small stiff brush. At 50° to 55° C. this causes no discomfort. Excessive hardening of the wax and elevation of melting point is avoided by using fresh paraffin. Electrodes so applied have been found to be as stable as those attached with collodion, and both electrodes and paraffin are readily removed by gently scraping away the paraffin with a coarse comb.

A Potometer for Rapid Measurements of Ingestion by Haustellate Insects

MABLE R. FRINGS and HUBERT FRINGS
West Virginia Wesleyan College

In an investigation of the nutrition of the blowfly, *Cynomyopsis cadaverina,* it was necessary to measure accurately amounts of food ingested by individual flies. Gravimetric methods for this are exact, but they are time consuming. To facilitate these measurements, therefore, a potometer was developed to make these determinations volumetrically. This potometer, beside its utility in studies on nutrition of flies, should be valuable as a tool for the rapid measurement of ingestion in testing the toxicity of insecticides. With appropriate modifications, it could easily be adapted for use with haustellate insects other than flies.

The construction of this instrument is illustrated in Fig. 1. It consists of a piece of capillary tubing, bent as shown, with a scale graduated in millimeters fastened to it by means of small pieces of wire. The bore of tubing used would be determined by the amounts of ingestion expected. One end of the tubing is slightly expanded and a small wick of filter paper (not shown in the figure) is inserted.

The potometer is filled at the plain end by means of a pipette, and the meniscus brought onto the scale by absorbing the excess fluid with a piece of filter paper applied to the wick. The insects are allowed to suck the fluid (a sucrose solution, in the experiments with *Cynomyopsis cadaverina*) from the capillary tube through the filter paper, and the amounts ingested are measured in millimeters by following the movement of the meniscus along the graduated scale.

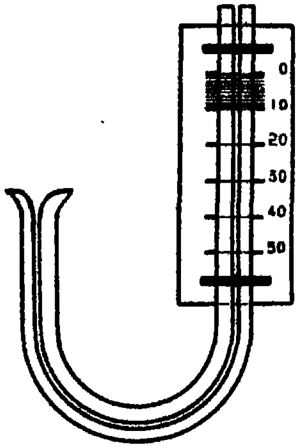


FIG. 1. Construction of the potometer. The bore of the capillary tubing is greatly exaggerated.

To convert amounts in millimeters, an obviously arbitrary measurement, to absolute volumes, the potometer must be calibrated. To do this, it is necessary merely to determine the weight of mercury represented by each centimeter along the scale, and then to convert this, using the density of mercury, into the volume represented. Benedetti-Pichler (*Introduction to the microtechnique of inorganic analysis.* New York: John Wiley & Sons, 1942. Pp. 256–260) gives complete detailed directions for such calibrations. With solutions of known concentration, the exact amount of dissolved material ingested by the individual animal can be measured readily when the potometer is thus calibrated.

One possible correction factor suggests itself. The fluid is evaporating from the wick during the feeding of the insect, and it would seem to be necessary to correct for the rate of evaporation. In our experiments the wick was kept so small that the oral lobes of the flies practically covered it in feeding, thus stopping this evaporation. Also, the rate of evaporation with sugar solutions, and even with distilled water, was found to be so low that there was no appreciable loss through this route for the short time during which each fly fed. This factor, therefore, can be eliminated with appropriate precautions, or it can easily be determined and taken into account in the readings.

Using this potometer, a preliminary study was made of the correlation between time of feeding and amount of fluid ingested to determine to what degree time of feeding could be used in place of amount. Twelve flies (6 males and 6 females) were used in the tests. These flies were mounted for ease of handling by fastening them on blocks of beeswax at the ends of glass rods. They were fed .5 M sucrose solution at 12-hour intervals, with distilled water supplied before each feeding. The results are presented graphically in Fig. 2.

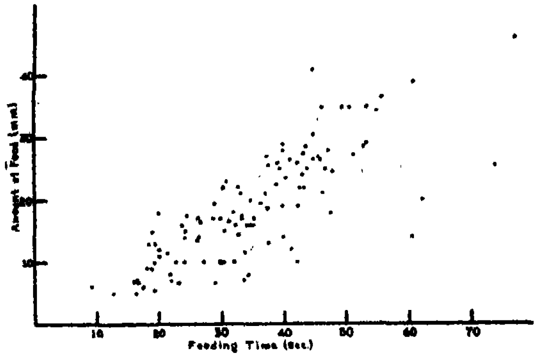


FIG. 2. The relationship between time of feeding and amount of food ingested for *Cynomyopsis cadaverina*.

There is obviously a high degree of correlation between time of feeding and amount of food ingested by this species, the coefficient of correlation (r) being .80 (Fisher's $z = 1.1$). With long times of feeding, however, as the graph shows, the time of feeding may not be an accurate index of the amount. This is probably due to the tendency on the part of some individuals of this species to allow the proboscis to remain extended after reaching satiety, thus giving a time record without really ingesting any food. For work in which a high degree of accuracy is not necessary, the time of feeding is obviously a good measure of amount of food ingested. Where precision is necessary, however, in the measurement of actual amounts, the feeding time is invalid.

A New Glass Device for Staining Cover-Glass Preparations[1]

RALPH WICHTERMAN
Temple University

Frequently biologists and others who are obliged to work with preparations affixed to cover glasses use methods whereby individual cover glasses must be transferred through fixing fluids, stains, alcohols, and clearing media before being mounted on slides.

---

[1] Cover-glass staining devices have been described by F. Baer (*Stain. Tech.*, 1929, 4, 59–60), R. H. Bowen (*Stain. Tech.*, 1929, 4, 57–58), and T. T. Chen (*Stain. Tech.*, 1942, 17, 129–130). However, one who has experienced the staining of large numbers of cover-glass preparations should find obvious advantages in this new glass device.

Two such methods are widely used: In one, the cover-glass preparations are handled in Petri dishes, each of which accommodates about seven cover glasses. In this method there is always the danger of one cover glass sliding upon another and damaging the preparation. The other method requires the use of special staining wells which are grooved to receive four cover glasses. In both methods the cover glasses must be handled individually with forceps. This is not only tedious when large numbers of preparations are to be stained, but it is difficult or impossible to have all preparations stained for exactly the same lengths of time.

To overcome the objection to the use of Petri dishes and ordinary staining wells, I have constructed a device which permits the staining of ten cover-glass preparations (or twenty when placed back to back) in a *single operation*. The device (Fig. 1) consists of a slotted glass carrier to hold the cover-glass preparations, a spring-type handle for the carrier, and a glass container with lid for the reagent. The carrier is small and compact, with ten grooves on the inside of each of the long sides. Into these grooves are placed the circular or square cover-glass preparations of the size most commonly used, namely, 22 mm. (⅞ in.) wide. A thin strip of glass at the bottom and center of the carrier holds the cover glasses in place, and the space on each side of this strip permits the fluids to enter and cover the preparations when placed in a dish of reagent. In a staining procedure, there are frequently ten or more different reagents into which the preparations are to be passed. Of course, there should be a dish for each reagent. The size of the glass carrier (5.5 × 2.5 × 4 cm.) is such that two of these can be placed side by side in the standard glass dish that is ordinarily used for the carrier holding 1 × 3-in. glass slides.

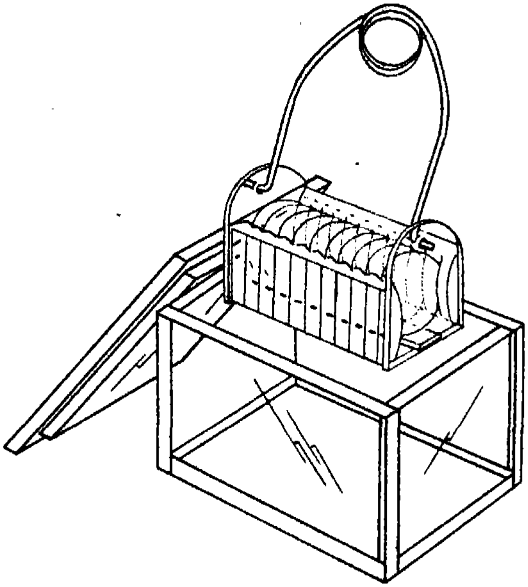


FIG. 1. Device for staining preparations mounted on cover glasses. The open-bottomed glass carrier with wire handle is shown with ten cover glasses in place for staining. Glass dish and lid are also shown.

Protozoologists, parasitologists, cytologists, bacteriologists, and others, especially those working with blood smears on cover glasses, should find the device useful. Its use in the Feulgen staining reaction is apparent. Not only does it eliminate what has been a very tedious and time-consuming operation in the past, but also it enables one to obtain uniformly accurate results in working with large numbers of preparations.

Scanning Science—

At the fortieth meeting of the Geological Society, on January 9th, the first paper read was by Mr. R. T. Hill, of the U. S. Geological Survey, On the Agassiz Expedition to Panama and Costa Rica.

The speaker made acknowledgment to the following specialists who had determined for him many different types of material entering into this complicated section: to Dr. Wm. H. Dall, of the Geological Survey, for a report upon the Tertiary Mollusca; to Prof. R. M. Bagg, of Johns Hopkins University, for interesting determinations of the Tertiary Foraminifera; to Prof. J. E. Wolff, of Cambridge, to whom the petrographic specimens were assigned; to Mr. H. W. Turner, of the Geological Survey, for minute examination of certain important and apparently indeterminate earths; to Mr. Aho Sjorgren, of Stockholm, Sweden, late of Costa Rica, for carefully prepared sections and collections; and to Mr. T. Wayland Vaughan, of the U. S. Geological Survey, for determination of the fossil corals.

—24 January 1896

Letters to the Editor

Growth of Trophoblast in the Anterior Chamber of the Eye of the Rabbit

Criteria which have been established for characterizing malignant tissue by means of the technique of transplanting tissue fragments into the anterior chamber of the eye of rabbits appear to be fulfilled by trophoblastic tissue. Trophoblast obtained from human placentae of about five-month pregnancies grows rapidly in the anterior chamber and infiltrates the eye. These results confirm similar work performed by Kido in 1937 (I. Kido. *Centralbl. Gynack.*, 1937, 61, 1551; *Ber. wiss. Biol.* (Maly's), 1937, 44, 493). Experimental details will be published elsewhere.

CHARLES GURCHOT and ERNEST T. KREBS, JR.
San Francisco, California

The Pelletier and Caventou Monument in Paris

Among the bronze monuments melted down for conversion into weapons in the countries overrun and occupied by the Nazis in World War II was the statue of the pharmacists, Pelletier and Caventou, the discoverers of quinine, erected in Paris in 1900 and paid for by contributions from all parts of the world.

It would be an excellent manifestation of good will if American scientists, if the American people, would replace the destroyed statue by another and more beautiful one. The new monument would stand not only as a renewed tribute to a scientific deed of highest value to the human race but simultaneously as a symbol of the victory of humanity over brutality.

If this suggestion meets with general approval, a committee should be formed to deal with the questions concerned (collection of necessary funds, communication with the Société de Pharmacie de Paris, the American and French authorities, etc.).

The undersigned would be only too glad to aid in the realization of this project to the best of his ability.

GEORGE URDANG, *Director*
American Institute of the History of Pharmacy
Chemistry Building, Madison, Wisconsin

Some X-Ray Crystallographic Data on DDT

In the course of an X-ray and optic study of analogues of DDT we have had occasion to include DDT itself. Our results do not agree completely with those reported previously by G. L. Clark and F. W. Cagle, Jr., in a note to this journal (*Science*, 1945, 101, 465–466). DDT crystallizes in the orthorhombic system, and our lattice dimensions agree fairly well with those reported. Beyond this point no agreement exists.

The material used was a highly purified sample of DDT obtained through repeated recrystallizations from ethanol, having a melting point of 108.5–109° C. The crystals were long tabular needles. An optic study showed the β vibration direction to be along the needle length. DDT is a positive biaxial crystal with γ normal to the main face. These data agree with the optic study made by E. L. Gooden (*J. Amer. chem. Soc.*, 1945, 67, 1616–1617).

X-ray data were obtained from Weissenberg diagrams about all three crystallographic axes. The unit cell dimensions are:

	OUR DATA	CLARK, *et al.*
	$a = 19.14 \pm .08$ A. U.	$a = 19.25$
	$b = 9.96 \pm .04$	$b = 10.04$
(needle axis)	$c = 7.85 \pm .04$	$c = 7.73$

The space group is P_{bc} or P_{bcm} and not $P_{2_12_12_1}$ as previously reported by Clark and Cagle. The density was measured by suspending the crystals in an aqueous KI solution of the same density, which was 1.556. There are four molecules per unit cell. The X-ray molecular weight is 353 as compared to 354.5 computed for $C_{14}H_9Cl_5$.

Powder diagrams check with the data published in *Science*, but we have been unable to confirm the indices assigned to many of the lines.

I. FANKUCHEN, M. SCHNEIDER, and J. SINGER
Polytechnic Institute of Brooklyn

The Best Defense

The challenge hurled at civilization by the atomic bomb not only provides motivation for men of different nations to live in peace, but also signalizes a procedure by which they may learn how to do this. For if, by employing the scientific method, men can come to understand and control the atom, there is reasonable likelihood that they can in the same way learn to understand and control human group behavior.

It is most unfortunate that science is being considered in the current press as merely the body of knowledge mankind has amassed about certain phenomena. During the Middle Ages an equally tremendous body of knowledge was accumulated which was in no way science. The important thing about science is the method of observing, classifying, and generalizing so that the body of knowledge is verifiable. This method has proved more useful in each field in which it has been exploited than any other method employed in that field.

Human behavior, like atomic behavior, is a natural phenomenon, capable of observation, classification, and generalization according to the same rules by which science has been so successful wherever it has been applied to natural phenomena. It would seem evident, therefore, that *social science*, in the strictest sense, offers a defense against further use of the atomic bomb with a greater probability of success than any other method now known.

Three or four years ago when warring peoples desperately felt the need of victory, it was not thought for a moment that this motivation alone would produce victory.

Techniques were required. It is equally absurd now, when peace is such a desperate necessity, to suggest, as men of intelligence are doing, that *the motivation provided by the fear of the atomic bomb will alone keep the peace* without the aid of techniques. It is quite within reasonable probability that social science can provide these techniques if it is given anything like the amount of support afforded to physical science in developing the atomic bomb.

The notable acceleration since 1930 in the gains made by social scientists, and the presence in the world of perhaps a few dozen of these men who are highly skilled in the techniques of their discipline, augurs well for a trial of the scientific method in discovering ways of maintaining peace. It is not as if a start had to be made from total ignorance. There is already at hand a very considerable body of knowledge as well as steadily increasing excellence in the means of enlarging it.

But while the social scientists seemingly must be responsible for discovering a means of preventing war, if it is to be discovered, the physical, biological, and medical scientists are at present possessed of nearly all the tremendous prestige that goes with the word *science*. Up to now no authoritative voice of any considerable group of physical, biological, or medical scientists has been raised in support of their co-workers in social science—of those who share their method of observing, classifying, and generalizing natural phenomena.

These more famed colleagues of the social scientist are probably not versed in his recent accomplishments; perhaps they are not fully aware that he uses the same method of science that they use; more than likely they have formed their opinions after listening to quacks posing as social scientists.

Is it not time for physical, biological, and medical scientists, whose prestige is so great, to investigate the work of social scientists thoroughly enough to ascertain whether it is, in truth, science? And if they find that it is, can they not do more toward keeping the peace than merely informing persons in authority, and others, of the terrible consequences of the atomic bomb in case of a war? Can they not unite and give their great influence to support the work of social scientists toward finding techniques by which the peace will be maintained?

Raymond E. Bassett

Gorham State Teachers College
Gorham, Maine

On Opening "Frozen" Vacuum Desiccators

I have read with interest the method for opening "frozen" desiccators described by J. D. Reid (*Science*, 1945, 102, 483), which consists of driving a single-edged razor blade between the top and body of the desiccator. I have used this method myself successfully, but have always felt lucky that I did not chip or crack the top of the desiccator, since desiccator waxes of thick consistency are sometimes so tenacious that removing the lid becomes a major operation.

The method I have come to adopt is absurdly simple but always effective, and in the event that someone may not yet have discovered the method for himself I shall describe it here. The desiccator is held under a hot-water faucet, the water being allowed to flow over the edge of the lid. As soon as it becomes warm, the wax softens, and the lid is removed with ease. Only a few seconds are required to perform the entire operation.

William A. Hiestand

Purdue University

Information Please

In the early 1890's a one-room country school in Indiana was attended by two boys—classmates, both of whom became starred scientists. They have often wondered whether any other one-room country school in the United States has ever numbered two starred scientists among its alumni. The authors of this note, who were the boys referred to above, hope that any reader of *Science* who knows of a parallel or similar case will present the facts in a communication to this magazine. The likelihood of an occurrence of this kind by pure chance is not known but must be very small. If, as might reasonably be estimated, there is not more than one chance in a thousand that such a school has enrolled even one starred scientist, the likelihood of its enrolling two would be only one in a million on the basis of chance alone. In the instance here reported the laws of chance may have been upset by the fact that the teacher of the boys was exceptionally capable and inspiring.

It is suggested that replies to this appeal include instances of other comparable recognition—membership in the National Academy of Sciences, listing in *Who's Who*, etc.—and that mention be made of extrachance factors that may have been involved.

B. and T.

The Rumbling of Thunder

Arthur Taber Jones (*Science*, 1945, 102, 407) calls attention to an especially continuous and pronounced case of the rumbling of thunder on the morning of 30 August 1945, at Northampton, Massachusetts, and cites W. J. Humphreys, who, in *Physics of the air*, lists four causes for the rumbling of thunder: (a) inequalities in the distance from the observer to various points of the path of the lightning; (b) crookedness of the path; (c) succession of discharges; and (d) reflection.

There is no doubt that all these factors enter into the cause of the rumbling of thunder; but there occurs to the writer another cause which he believes to be even more potent than any of the four named above. As is well known, thunder is caused by the sudden change in temperature of the air through which electricity is passing during a lightning flash. In order to understand clearly the operations of the factor about to be described, let it be supposed that lightning flashes between two clouds so situated that the electric discharge comes directly toward the observer. When the discharge starts from the cloud of lower potential, we may assume the number of electrons, N, per unit of time to be very great. These N electrons are accelerated by the difference of potential between the clouds and, after having been accelerated, meet with molecules of the air; and in thus colliding with the molecules generate light quanta—the light of lightning. Part of the light thus generated, however, is absorbed by electrons in other molecules, in their immediate neighborhood. These absorbing electrons are liberated as photoelectrons or beta electrons and become a part of the electron beam which constitutes the lightning discharge. The original electrons which started from the negative cloud and made collision with air molecules after the initial collision recoil and are free electrons in a potential field. There are now $2N$ electrons in the discharge per unit of time. These $2N$ electrons are now accelerated, make collisions with molecules, and generate light quanta. This process is repeated many times during the discharge of electricity from the negative cloud to the positive cloud. At each repetition of the process the number of electrons in the discharge is doubled, so that there occurs in the electric discharge N, $2N$, $4N$, $8N$. . . . It is the generation of the radiation—ultra violet, visible, infrared, and radiant energy radiation—which produces the heat, which causes the expansion, which, in turn, sets in motion the air waves we hear as thunder. The rate at which the lightning travels between the clouds is nearly, though not quite, that of light. The rate at which sound travels is only a small fraction of the velocity of light. If, now, the lightning is traveling toward the observer and the sound is traveling in the same direction, the sound produced by the lightning in the last part of the lightning flash will reach the observer first; and since the number of electrons in the discharge, having doubled at each collision with molecules, have increased possibly a hundred-thousandfold, the heat expansion would be comparable and the thunder would be heard as a loud crash, at first, followed by a gradually decreasing rumble, fading out to a very low rumbling sound coming from the beginning of the discharge.

If the lightning discharge takes place away from the observer, the sound of the first part of the discharge will be heard first, and the thunder will gradually increase in loudness, ending with a loud crash.

If the discharge is in any direction other than the two mentioned, the thunder will be heard as some variant of the two patterns described. The time of the lightning discharge is very brief, as the duration of the flash indicates. The reason why the thunder is prolonged is due to the difference in the distance of the different parts of the discharge from the observer.

In the case referred to by Professor Jones there must have been a very great number of lightning flashes passing in different directions between different clouds. The fact that there was no visible lightning was unusual but entirely understandable to the science of electrical discharge. When electrons collide with molecules of air they generate radiant energy quanta, but not necessarily of visible frequencies. The low-frequency radiation generated produces heat, and the consequent expansion of the air produces thunder. We may therefore have a thunderstorm without visible light.

The above cause of the rumbling of thunder has been deduced from a general theory, not yet published, of electric discharges through air. There is no doubt that the four causes mentioned by W. J. Humphreys will have their influence in causing rumbling, but I believe that the chief cause for rumbling is the one elaborated above.

Samuel R. Cook

Sacramento, California

"Freezing" Behavior in Rats

Dr. Riess is properly conservative in the title of his recent article, "A possible explanation of 'freezing' behavior in rats," (*Science*, 1945, 102, 570), but the conclusions drawn in the report go somewhat beyond the data presented. It is stated that eighteen of the 124 rats raised in groups of six to a cage manifested the behavior in question, whereas only two of the "other group," raised in isolated, single cages, did so. The data are, of course, quite uninterpretable, statistically or otherwise, without a statement of the size of the "other group." Furthermore, the author evidently feels that his observations carry the implication of a connection between submissiveness, as developed in a social situation, and "freezing" behavior in the maze. Since three (of the eighteen) animals living in groups were "dominant and winners in fighting" (the other fifteen being submissive individuals), and since two animals who presumably had no opportunity for social interaction also showed "freezing," it would be more correct to say that the behavior may be related to social factors, or that social conditions seem to be *a* factor in producing the phenomenon, than to conclude that the behavior is "the result of the hitherto uncontrolled factor of social interaction in the living quarters of the experimental animals."

Prompt communication to fellow scientists of experimental results having wide current interest is certainly desirable and to be encouraged, but this desideratum is neither incompatible with, nor warrants the abandonment of, the usual standards of scientific reporting.

Henry W. Nissen

Yerkes Laboratories of Primate Biology
Orange Park, Florida

A Correction

In a recent note, "A possible explanation of 'freezing' behavior in rats" (Bernard F. Riess. *Science*, 1945, 102, 570), the author was guilty of a serious omission which completely vitiated the meaning of the article. A comparison was made between two groups of animals, one living in multiple-animal cages, the other in isolation. In giving a description of the groups, the population of the multiple-housed animals was given as 124 and that of the second group was inadvertently omitted. There were 84 animals in this second group. This makes it possible to evaluate the difference between the two groups. The author apologizes for the omission.

Bernard F. Riess

Hunter College

Book Reviews

Experimental catatonia: a general reaction-form of the central nervous system and its implications for human pathology. Herman Holland de Jong. Baltimore: Williams & Wilkins, 1945. Pp. xiv + 225. $4.00.

According to de Jong, catatonia is a neuromuscular reaction-pattern which, in its predominant hypokinetic form, is characterized by diminution of spontaneous motility, maintenance of static posture (catalepsy), and passive resistance to, or reversal of, induced movement (negativism); however, hyperkinetic tremors and impulsivity may also appear. The author acknowledges that a catatonic syndrome occurs in many diverse neurologic and psychiatric disorders, but he is primarily interested in the so-called "catatonic" subgroup of schizophrenic psychoses. In early studies at Amsterdam University (*La catatonie expérimentale par la bulbocapnine.* Paris: Mason, 1930) de Jong, Baruk, and coworkers observed that significant alterations of muscular tonus and movement could be induced in animals by the injection of bulbocapnine, an alkaloid chemically related to apomorphine; the author therefore inferred that catatonic schizophrenia might also be of toxic etiology in man.

The present volume presents abstracts of subsequent studies by the author and his associates at Columbia and, more recently, at Duke University. In brief, these studies showed that the motor and autonomic symptoms of catatonia could be induced by a great variety of other drugs, such as mescaline, epinephrine, acetylcholine, and even CO_2 inhalations, so that the author's original quest for a specific "catatonizing chemical nucleus" had to be abandoned. Further, while "the extent to which catatonic manifestations could be produced [by bulbocapnine] seemed to be related directly to the degree of development of the nervous system of the experimental animal [Lewis]," the catatonic states induced by experimental lesions of the brain could not be directly correlated with either the localization or the size of the lesions themselves. Catatonic disturbances of muscular tonus were also produced by an Eck's fistula or by the ligation of an intestinal loop in dogs, by passing electric currents (especially of the direct-interrupted Leduc type) through the brains of cats, or even by subjecting rats to rapid horizontal rotation or to intense auditory stimulation. Still in pursuit of a possible toxic factor in clinical catatonia, the author next undertook extensive research on a substance in human urine hopefully called "catatonine" (later shown to be "operationally identical" with nicotine and not specific for schizophrenia), on the histamine content of human blood, and on the cephalin-cholesterol flocculation test for liver function in schizophrenics and normals—all with indeterminate results. De Jong concludes, nevertheless, that catatonia is an expression of "cellular asphyxiation in the nervous system" and implies that the latter, as Kraepelin postulated, is probably due to some undetermined "auto-intoxication" of the body.

It may be seen that de Jong's approach to neuropsychiatry is still traditionally dualistic: an abstract "mind" is distinguished from a material "body," and all problems of behavior must be solved in terms of tissue function. From this orientation there follows his insistent pursuit of a single organic cause for "catatonic schizophrenia," which, clinically, is a vaguely defined, protean, and highly variable disorder contingent on a multitude of biodynamic determinants in the past experiences and current adaptive functionings of the organism.

Even granting the validity of so narrow an approach to the subject, the book has other, though less serious, defects. The discussion is thin and repetitious; records of the experiments are fragmentary and sometimes do not support the conclusions; the studies of other workers in the field are accorded scant notice; and the lack of an index makes cross-reference to the text difficult. Nevertheless, the work represents a sincere effort to report an almost life-long series of studies by an alert, competent, and persistent investigator and, as such, will furnish significant data to those interested in the comparative investigation of normal and abnormal behavior by valid and promising methods of animal experimentation.

JULES H. MASSERMAN

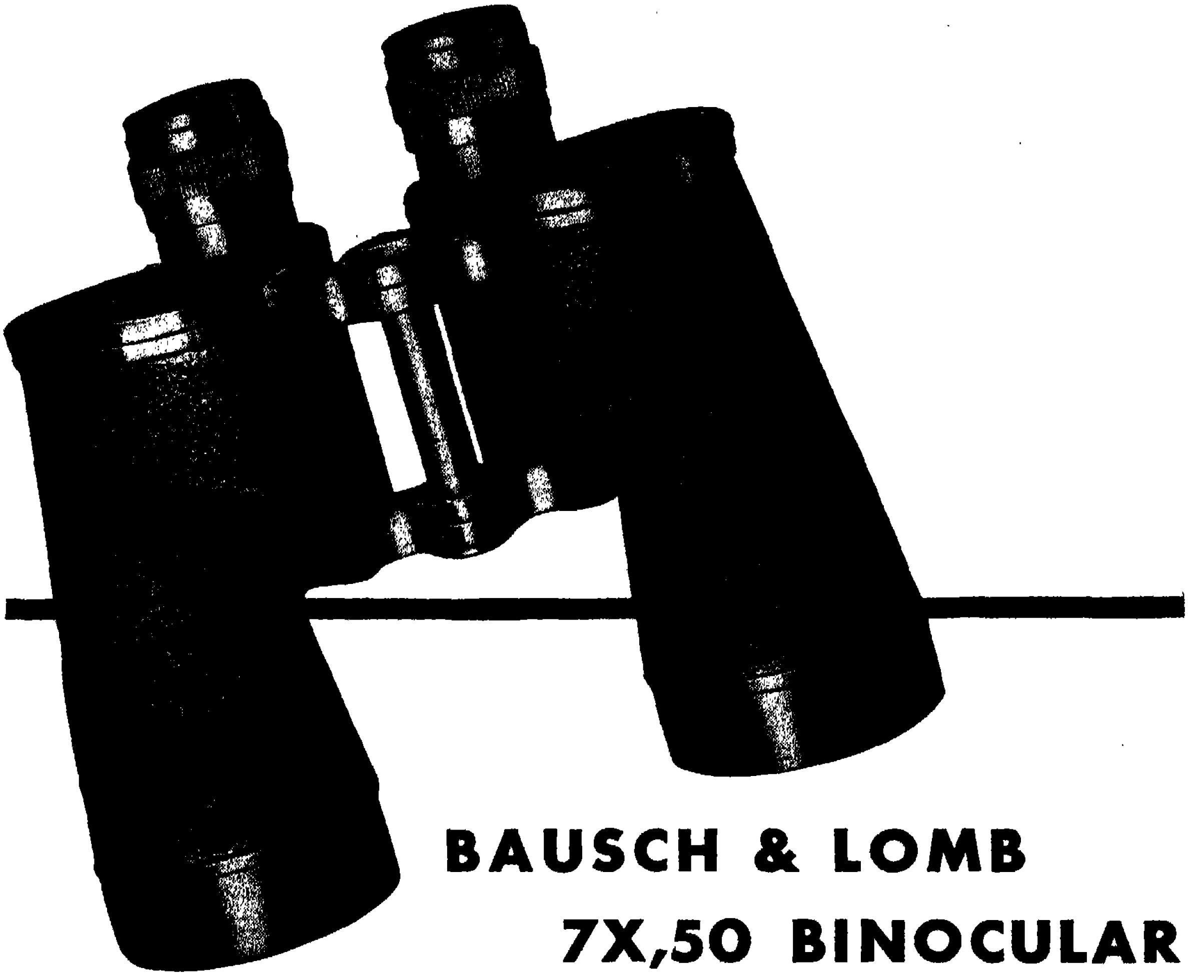
University of Chicago

American Old and Middle Tertiary larger Foraminifera and corals. Pt. I: *American Paleocene and Eocene larger Foraminifera.* Thomas Wayland Vaughan. Pp. x + 175; Pt. II: *West Indian Eocene and Miocene corals.* John West Wells. Pp. iii + 25. New York: Geological Society of America, 1945. Memoir 9.

This memoir is divided into three sections, the first two of which are by Vaughan and the third by Wells. The first portion describes the larger Foraminifera collected by Dr. A. Senn in Barbados, British West Indies, from rocks of Paleocene and Eocene age. The second section is a detailed account of the skeletal structure, development, and classification of the genera and species of the foraminiferal family Discocyclinidae, followed by a rather complete annotated list of the various American species assigned to this family. The final section of this memoir is a description of twenty-seven species of Eocene corals from Barbados and two species of coral from the Miocene of Martinique.

In Barbados, in the Joes River mudflows, there occur fossiliferous blocks which contain an assemblage of Paleocene larger Foraminifera. Most of the species recovered from these blocks are identical to those described from the Soldado formation on Soldado Rock, Trinidad. The formation from which these blocks were derived is not exposed.

The oldest exposed rocks are the Scotland formation, which is divided into a lower and an upper portion. The lower contains only one species, *Discocyclina (Discocyclina) grimsdalei* Vaughan and Cole. As this species appears to have a rather long stratigraphic range, the correlation of the Lower Scotland formation depends on



BAUSCH & LOMB
7X,50 BINOCULAR

This war tested binocular, built to the strictest, most exacting Navy specifications, is now available to you. It is water-proof, fungus-proof, dust-proof, and highly resistant to sudden temperature changes. Its precision optical system—plus Balcoted lenses—increases light tranmission to 78%, and minimizes flare and image degradation caused by internal reflection. Individual focusing eyepieces. 7.3° angular field provides view of 381 feet at 1000 yards. It's the last word in binoculars. You'll always be proud to own a B&L 7x,50. Folder G-29 tells all about them. Bausch & Lomb Optical Co., Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

the stratigraphic position of the formation. It is believed to be Lower Eocene. The Upper Scotland formation, which is subdivided into three members, contains a relatively rich fauna of larger Foraminifera and corals. Unfortunately, most of the latter represent new species, and the age of the Upper Scotland formation must be based on the general aspect of the fauna. The occurrence of *Pseudophragmina perpusilla* (Vaughan) and *Endopachys maclurii* (Lea) in this fauna, however, is a rather definite indication of the Middle Eocene age of the Upper Scotland formation.

In the systematic descriptions of the forms from Barbados, Vaughan describes a new genus *Orbitolinoides*, which resembles *Orbitolina* but lacks the peripheral zone crossed by radiating plates which is characteristic of the latter genus. Voluminous notes are given on the genus *Miscellanea*, and the various species of the Discocyclinidae are described and figured in great detail. A pustulate species of *Amphistegina*, related to *A. lopeztrigoi* Palmer from the Middle Eocene of Cuba, is described by Cushman in this section of the memoir. The description of a new species of *Polylepidina* and unnamed *Pliolepidina* concludes the section on the fauna from Barbados.

The second section will be of tremendous value to all students of the Foraminifera, since it represents a monographic treatment of the American Discocyclinidae. The discussion of the various species is preceded by an elaborate account of the structure of the test. Vaughan demonstrates by means of microtome thin sections, prepared by Dr. E. H. Myers from specially treated specimens, that one species of *Discocyclina* has annular intramural and radial intraseptal canals, confirming previously held opinions that the Discocyclinidae should be separated from the Orbitoididae and Miogypsinidae.

The classification adopted by Vaughan is essentially the one given by Vaughan and Cole in Cushman's textbook on the Foraminifera, with the addition of the subgenus *Asterophragmina* proposed by Rao in 1942. In the review of American species Vaughan proposes six new species and two new varieties and gives notes or detailed descriptions for forty-six previously described species and three varieties. The systematic portion of the second section would have been more valuable if a complete synonymy had been given in each case.

The second section is concluded by the stratigraphic zonation and geographic distribution of the American species of Discocyclinidae as well as a table in which the locations of the type specimens are given. The illustrations are excellent. Special notice should be given to the many perfect thin sections, because, if these are inadequate, it is impossible to obtain satisfactory photographs and delineation of diagnostic structures.

The final section, by Wells, describes the scleractinian coral fauna of the Upper Scotland formation, in which twenty-seven species and varieties were discovered. Although most of the species and two of the genera are new, the general aspect of the coral fauna is that of the Middle Eocene Claiborne coral fauna of the United States and not similar to other known West Indian Eocene coral assemblages. The fauna suggests that the forms lived in a tropical, nonlittoral environment at depths beyond the lower limits of temperature for vigorous reef growth. Of the two corals described from the Miocene of Martinique, one was known previously from a single Dominican specimen, and the other, a new species, is referred to the subgenus *Eusthenotrochus* previously recorded from the Eocene of the Paris Basin and the recent seas.

W. Storrs Cole

Cornell University

Introduction to organic chemistry. **(6th ed.) Alexander Lowy, Benjamin Harrow, and Percy M. Apfelbaum. New York: John Wiley & Sons, 1945. Pp. xiv + 448. $3.50.**

The sixth, revised edition of this textbook incorporates changes from the preceding edition which represent a steady evolution to keep the book up to date rather than a sudden change. The book therefore retains its essential qualities—clearness, simplicity, and logic of presentation—and avoids the pitfall of numerous other texts which, in their recent revisions, have tried to cover too much and have become unsatisfactory hybrids between elementary textbooks and advanced treatises.

Here we have, as the title claims, a true introduction to organic chemistry. It uses some electronic notations discreetly. The reviewer has quarrels of only minor importance with the authors. Although recognizing that the book seldom explains a topic in terms of something that follows, he finds the paraffins, prepared from acids, and the olefins, prepared from alcohols, in chapters where the students have not yet learned oxygenated functions. It seems more logical to teach that alcohols are hydrated olefins than that olefins are dehydrated alcohols. The description of recent industrial achievement is seldom permitted to distort the general knowledge, yet the description of the nitroparaffins is misplaced, because it destroys the notion of paraffinic sluggishness which it is essential for the student to grasp. The same criticism applies to rearrangement on aluminum chloride, which confuses the student when it is brought up too soon. These topics could easily be displaced into a separate chapter in which it could be emphasized that such reactions become preponderant because of the drastically different operating conditions. The reviewer would also like to see the Wurtz reaction emphasized as one of theoretical, more than practical, interest, since he finds that students are unusually prone to propose any number of condensations using this apparently obvious procedure.

The book is well presented and makes a distinctly better impression than its preceding edition.

Albert L. Henne

Ohio State University

Introduction to industrial chemistry. **W. T. Frier and Albert C. Holler. New York: McGraw-Hill, 1945. Pp. xiv + 368. $3.00.**

This book, written for the benefit of industrial employees taking night-school work, covers a number of independent, apparently hand-picked topics, as shown by the Table of Contents: atoms; molecules and valence; plus and minus valence; radicals and acids; acids, bases, and salts; energy relations in chemical reactions, reduction and oxidations; production of iron and steel; slags and high-temperature chemistry; aluminum; magnesium; other applications of electrochemistry; the manufacture of chemicals; silicates, glass, and colloids; ceramic and cement; industrial water; fuels and combustion, organic chemistry (theory); plastics; rubber; and the refining of petroleum.

A first reading gives at once the impression that the authors are in earnest and are trying their best in the interest of their students, for whom they obviously feel a warm sympathy. It may be that this is the type of semiscientific information which is best suited for the purpose. The reviewer feels, however, that it is preferable to present the subject in the frankly untechnical manner of writing for the intelligent layman to be found in the *New York Times*, for example. The present method uses repeatedly oversimplified information, which is quite all right, but includes chemical terminology in sufficient quantity to disguise this fact, and the reviewer feels that this may give the students the impression that they know more, or understand more, than they actually do. The reviewer also looks askance at the kind of similes introducing Chapter II, which liken the desire of the atoms to live together in molecules to the fact that a man will be attracted by the earth if he walks off a roof, or to the difficulty of pulling apart two surfaces of polished metal. Since the book is to be used by novices, it would be well to use pictures of molecular models made of colored balls and pegs. The Hirschfelder models are admittedly more correct, but they do not speak to the imagination of the uninitiated.

ALBERT L. HENNE

Ohio State University

Physics of the twentieth century. Pascual Jordan. (Translated by Eleanor Oshry.) New York: Philosophical Library, 1944. Pp. xii + 185.

Those interested in the philosophy of science, whether they be professional scientists, philosophers, or intelligent laymen, will welcome this discussion of the epistemology of modern physics. Well written in nontechnical terms and apparently excellently translated (though the reviewer has not had access to the original) the book discusses first the assumptions of classical physics, followed by a lucid treatment of the simpler facts of modern physics and the revision in methodology which these facts, particularly quantum and wave mechanics, have made necessary.

The author, like some others, prefers the positivistic approach to the problems involved in attaining scientific knowledge. He considers metaphysical speculation concerning the *essence* of physical reality as unprofitable and dangerous to science, thus limiting the "philosophy of science" to a consideration of scientific epistemology or ways of knowing. "Up to our time," he writes, "the opinion has remained that it is the task of philosophy to clarify certain 'final' and most general questions of natural science; questions which concern perhaps the 'existence' of matter or the 'existence' of time and space or the 'existence' of force or the 'final' bases of 'ex-

*"Anatomy as a living subject"**

Mainland's

ANATOMY

By DONALD MAINLAND, M.B., D.Sc., Professor Anatomy, Dalhousie Univ.; *880 pp., illus., $7.50*

ANATOMY COMES ALIVE—the first *new* approach in generations. These comments are typical of all appearing in the medical press on this important new text . . .

J.A.M.A. says: "For learning the practical anatomy useful to practitioners, here is one of the best books ever written. Neither storehouse nor dissection guide, its plan and treatment are original, the result of long experience by a capable, conscientious teacher. Those who work conscientiously under its guidance will become good doctors, good thinkers."

*"REVOLUTIONARY, and greatly to be praised. A refreshing anatomic-clinical conference, anatomy as a living subject," says the *Southern Med. Journal.* "Congratulations to Dr. Mainland for this revolutionary, sensible approach."

J. Assoc. American Med. Colleges writes: "Dr. Mainland approaches his task as anatomy related to the practice of medicine—a modern and different approach. The ideal text in anatomy."

"MUCH IN THIS BOOK beyond dry bones, injected muscles, dead viscera," writes *Calif. & Western Medicine.* "On every page the activities of the living body are invoked to explain and enlarge what dissection reveals."

- - - - - *convenient order blank* - - - - -

Sci. 1/46

PAUL B. HOEBER, INC., *Publishers*
Medical Book Dept. of
HARPER & BROTHERS
49 E. 33rd St., New York 16, N. Y.

☐ Please send Mainland's ANATOMY *@$7.50*

☐ On approval ☐ Charge ☐ Check encl.

Name .... Address ....

istence.' " Hence, "the only possible modern philosophical work which will be useful and fruitful for natural investigators must concern the theory of the method of natural scientific thought—for example, the questions of the theory of knowledge."

The lay reader who is interested in the developments of modern physics, but who is at the same time philosophically naive, will be stimulated by this exposition of scientific positivism. While the professional scientist will find no new information, he might do well to examine the assumptions of his own thinking in the light of this treatment. The theologian who seeks a scientific basis for his religious faith will, of course, find scant comfort. Yet, the book is a "must" for this group, because positivism is the scientific credo (or lack of it!) for an ever-increasing number of scientists. For those groups the book is recommended.

WAYNE B. DENNY

Oberlin College

Check-list of birds of the world. **(Vol. 5.) James Lee Peters. Cambridge, Mass.: Harvard Univ. Press, 1945. Pp. xi + 306. $5.00.**

This is the most recent unit of the indispensable synopsis of avian taxonomy begun by this author in 1931. The plan in no way differs from that of the earlier segments. The usefulness of the work and the prevailingly high quality of Peters' taxonomic judgments are well known to every professional ornithologist. The accuracy and scholarship of the writing are of the first order. No treatise of this scope has been undertaken since completion of the now-outmoded *Handlist of the genera and species of birds* in 1909 by Sharpe.

Peters' Volume 5 deals with the following orders: Apodiformes (Trochilidae only), Coliiformes, Trogoniformes, and Coraciiformes. The hummingbirds, or Trochilidae, occupy over half the work and are a particularly difficult group. The genera of this family total 123, although there are only 327 species. One wishes for some organization of these genera into subfamilies. Basic revision of the hummingbirds is not feasible in the course of preparation of a world check-list. Peters largely follows Simon, the latest reviewer, but stresses the fact that generic differentiation has been overdone and offers a good point of advice for future students—construction of a system of generic classification based on the characters of the more conservatively differentiated female hummingbirds. The author records many worthwhile observations on hybrids, artifact trade skins and allocations of names and types such that substantial progress in the taxonomy of the group is made.

Probably no one will be able to offer a highly improved treatment of this peculiarly New World family who has not spent much time himself observing and collecting hummingbirds in the Neotropical region. The extreme mobility of these birds, the tendency toward vagrancy, the not infrequent differential migration and habitat preference of males and females, the elaborate and confusing aggressive and courtship displays, and the brief, merely essential, association of the sexes in the breeding season in many species are complicating aspects of hummingbird biology that require this direct experience. The prospect of a definitive revision from the indoor school of "trochilidists," dealing largely with hummingbird "curios" imported from unfamiliar regions, seems slight indeed.

ALDEN H. MILLER

University of California, Berkeley

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Water demineralizer for laboratories. A practical demineralizer which provides an easy and quick way to obtain mineral-free water by using ion-exchange resins for purification has been announced by the Barnstead Co. It is a compact, effective purifier with flow rate range of 5 to 15 gallons per hour. The Bantam model is particularly convenient for any application requiring a relatively small volume of demineralized (deionized) water because it employs a renewable resin cartridge and operates without attention or regeneration. The disposable cartridge eliminates the necessity of regenerating with acid and alkali solutions, backwashing, rinsing, etc. *The Barnstead Bantam Demineralizer, Bulletin 111 SC–461.* Barnstead Still and Sterilizer Co., Inc., 2 Lanesville Terrace, Forest Hills, Boston 31, Mass.

Precision measurement of absolute pressure. The Wallace and Tiernan Company has developed a new absolute pressure indicator for the accurate measurement of high vacuum with respect to atmospheric pressure. Often such measurements are complicated by the lack of adequate barometric pressure indicators or by errors entering into the correction computations. To overcome these difficulties this new instrument measures the vacuum in terms of pressure above absolute zero. The indication of the true vacuum is particularly important in such fields as radio tube loading and high vacuum distillation. *Technical Publication 256 SC–461.* Wallace and Tiernan Products, Inc., Belleville 9, N. J.

Built-in cabinet slide-viewer. The Technicon Company is able to supply a compact slide-viewer which is built right into the end of the file drawer in which the slides are kept. The "Technilume" occupies only four inches of space and the balance of the drawer is freely available for filing microslides, Kodachromes, or lantern slides. Any slide in the drawer may be quickly checked by merely holding it against the front spot-viewer, which is flush with the front cabinet surface. The viewing discs are of opal glass and provide evenly diffused illumination without "hot-spots" and cooling louvres set into the sides of the light chamber permit the light to remain on indefinitely without overheating. *The Lab-Aid "Technilume" Leaflet SC–461.* The Technicon Company, 215 East 149th Street, New York 51, N. Y.

SCIENCE

Vol. 103, No. 2663 Friday, January 11, 1946

New Opportunities and New Responsibilities for the Psychologist[1]

John G. Jenkins, Captain, H(S), USNR

Navy Department, Washington, D. C.

WE ARE NOW ENTERING the after-dinner phase of psychology in World War II. The hunger-pangs that disturbed us a short time back are now quieted to the point of satiation. The cortical cells are experiencing that pleasantly-toned anoxemia that takes place as digestion exerts its priority over cerebration in the employment of vital bodily fluids. It is time to push back the chairs, to light up cigars, and to reflect on how well we have done by our country, by our profession, and by ourselves in the war years just past.

The reflection becomes all the more pleasing as we are made aware of the contrast between 1941–1942 and 1945. It may not be too much to say that most of us here at this meeting came into the military services through the servants' entrance. We were brought in, in an era of gloom and defeat, under the conviction that things were so bad that any available magic should be tried, even psychology. We have worked four years, more or less. Now we are going out the big front door, labeled as military specialists, while the band plays "Hail to the Psyche." Victory has replaced defeat; concrete realization of what psychologists can do has replaced a vague hope that they might possibly do something; and a warm and cordial acceptance has replaced a suspicious and grudging admission to the military work-place.

It is indeed a time to pass the brandy—at least figuratively. It is a time to make preparation for the moment when we shall stand in front of the assembled regiment or ship's company and hear the general or the admiral recite aloud our virtues. It is a time to lean back in our seats and harmonize on a few stirring verses of "The Cortex, the Cortex, Forever." And, above all, it is a time to look forward to returning to our several campuses as recognized experts.

Yet even as we relish the finer moments of the glowing after-dinner mood, we are uneasily aware that we shall never return to the campuses we left, at least as we knew them. The good, well-rounded world of 1928 and of 1938 is gone forever. It would ultimately have been destroyed, in any event, by the social currents of which the war was only an epiphenomenal symptom. It was already in its last days when we marched off in self-conscious awareness of our new uniforms, four years ago. But it was not allowed to die a natural death. Its final destruction came about through an explosion. An American airplane dropped a bomb no heavier than a week-end suitcase. A small city was destroyed; and with it was destroyed much of the basic framework of the social world we inhabited before the war.

So we sit here uneasily, you and I, pondering the fact that the whole parameter of personal success bulks very small indeed in a world which is earnestly trying to find out whether the human race must necessarily destroy itself. Official kudos, medals, the offer of a better job—all these things seem curiously unimportant as we try to revise our scheme of things to fit a world in which a city may vanish in the flash of an eye and a whole nation may perish between sunrise and sunset.

Instead of the long-anticipated era of congratulation and self-congratulation, then, we find ourselves in a period of searching self-examination. Instead of counting our medals, we are engaged in taking a stock of the primitive tools with which we must hope to master an unending task of incredible difficulty in the years ahead. I should be running vainly counter to the most significant intellectual trend of my professional lifetime, then, if I were to devote this hour to the more or less conventional and expected review of the fine things we have done. Instead, the occasion requires that I shall spend the time trying to assay what we have and what we may hope to do with it. The humility that anyone must necessarily feel when confronted with such a task is not decreased by the realization that editorial writers are now inviting the social scientist to enter a game of chance in which the stakes are the survival of the human race.

---

[1] From an address delivered at the Conference on Military Contributions to Methodology in Applied Psychology, held under the auspices of the Military Division of the American Psychological Association at the University of Maryland, 27–28 November 1945. The full text of the address and of the papers presented at the Conference will appear in a volume to be published by the University of Maryland.

What I have to say to you about the new opportunities and new responsibilities of the psychologist will be understandable and acceptable in proportion as you are willing to agree to my thesis that psychology is now entering a third phase of its development. The first phase, extending roughly from its founding down to about the 1920's, was the phase of *local* loyalty. The second phase, from the 1920's to the 1940's, has been the phase of broadened *professional* loyalty. The third phase which we are now entering must, of necessity, be the stage of *social* loyalty and *social* responsibility.

Please do not bother to object that phases in the genesis of any science are not as clear cut as that. I know that as well as you do. It is quite true that there are many individuals who fall outside the pattern of these phases. You may be sure, then, that I am not trying to describe any series of universal and all-inclusive temporal groupings. I am trying only to suggest a modal pattern, attempting to locate the movement of the majority of the profession, and content to allow the exceptions to fall where they may.

In that light, let us return to the thesis of the stages. As psychology developed through its first half-century of existence, local loyalties tended to run high. One belonged to a department which possessed the Only True Path; the rest of the field was tenanted by infidels who followed false gods. Wundt, when asked about Stumpf, whose laboratory was only a few miles away, was merely reflecting the spirit of the times when he said that he had never heard of Stumpf. Titchener was wont to dismiss the efforts of some of his extramural colleagues with the statement: "That may be all right, but it isn't psychology." There were not only schools of psychology but local brands of schools. Facts were few; logical constructs were numerous. The whole setting lent itself nicely to fine differences between *mine* and *thine*. The speaker, coming into psychology in the early 1920's, found himself in the midst of this. It was a good lusty era in which you joined up with a psychological team, ordinarily on the basis of a geographical accident, and thenceforth fought lustily to show that your team was right.

Phase Two was a natural evolution from Phase One, as facts accumulated and methods became less particularized. Just about the time that someone thought of getting out a volume on the 'schools of psychology' the schools themselves began to lose their identity and their sharp competitiveness. As early as 1926, one outstanding behaviorist confessed to the writer that a seminar which he had convened to justify behaviorism had convinced him that he was himself not a behaviorist.

Set the dates where you will, the trend remains unmistakable. There is no better proof than to ask you here to look around and determine what 'school' your immediate neighbors belong to. The chances are excellent that you will fail completely at this task. It may not be too much to say that each 'school' has had certain protests to make. It has made these protests, which were then absorbed in the main body of a research psychology, after which the main body moved along. There are few of us today who cannot acknowledge personal debts to Structuralism, Functionalism, Behaviorism, *Gestalttheorie,* and the teachings of the psychoanalysts. Beyond these broad divisions, we have also been stimulated in considerable amount, and with considerable profit, by contact with topology, with operationism, and with emergent evolution. We have gained from our contacts with such varied approaches as nondirective interviewing, projective testing, factor analysis, and the studies of expressive movement—to name only a few influences. But increasingly our identification has been with research psychology as a whole, rather than with any special movement or any particular set of techniques.

World War II has afforded the best demonstration that Phase Two has been a reality. The man from Nebraska has worked alongside the man from Palo Alto without the need of an interpreter. The young officer who had his statistics under Thurstone has found much common meeting ground with the lad who had studied under Kelly. There has been much stimulation in this business of working together and precious little intramural strife. Today, as never before, research psychology is a discipline which is much bigger than local loyalties and much wider-reaching than the confines of any school. And, unless you yearn for the complacent security of the Old School Tie, you will say that this is good.

It is good, I agree; but it is not enough. We must now be ready to enter a third natural phase of development. In Phase One, we demanded that a man belong to the Right School before we would break bread with him. In Phase Two, we ceased to ask him what school he had attended; we asked chiefly that his work should be sound, that he should check his critical ratio, and that his conclusion should not outrun his data. In Phase Three, the satisfaction of the one-per cent level of statistical confidence will not in itself be enough; we shall now have to ask not merely whether a result has *statistical* significance, but also whether it has *social* significance. When that becomes commonplace, we shall have entered Phase Three.

You will readily understand, I am sure, that this is not a matter of choice. If we do not ourselves freely adopt the idea of checking the social significance of our findings, it will be thrust upon us from outside the profession.

Well, you may say, we do all that already. We psychologists have our Society for the Psychological Study of Social Issues. We teach courses in social psychology. In our local communities we have worked with social problems and gone afield to meet social issues. So we are already in Phase Three.

If you can make such an answer, you show that you have failed completely to grasp how broad are the implications of membership in Phase Three. Social responsibility does, of course, include a willingness to meet and deal with social issues. But it goes far beyond that. Social responsibility for the research psychologist touches his professional life at every point. It determines what problems he shall select for his attack. It determines, to a considerable extent, what shall be accepted as methodologically respectable methods of attack upon these problems. It also determines, to some extent, how he shall interpret his findings and how and where he shall publish his interpretation.

It will be quite apparent to you that no one paper can hope to explore the varied implications of social responsibility for the social science investigator. I therefore propose to limit my discussion to what may be, for some of you, the least obvious aspect of the implications. That will mean that I shall attempt to indicate how—as I see it—a continuing sense of social responsibility affects and influences the very problems upon which he chooses to conduct his researches.

Let me begin by stating a postulate which attempts to describe the motivation of the choice of problems for research. Stated in its baldest terms, this runs about as follows:

As long as choice of problems is primarily determined by a feeling of *professional* responsibility, the investigator is most likely to select problems which hold promise of early returns, obtained by conventional methods. In other words, professional responsibility seeks out problems in terms of their promise of methodological neatness.

A sense of lasting *social* responsibility, on the other hand, demands that trained investigators turn their attention to the most pressing social problems. Neatness of result—and its accompanying professional acclaim—must often be sacrificed in order to attack problems which, although not promising early or definitive returns, are of immediate importance to social stability.

Some of you may say that that is an indictment. It implies that applied psychology has dodged some of its social responsibilities. But let us review some of the evidence.

PSYCHOLOGICAL TESTS

Suppose we begin by looking first at what is perhaps the psychologists' best-known working tool—the psychological test. Psychological testing saw its birth during World War I and reached its greatest peak of usefulness, up to this time, in World War II. Papers presented during this Conference have shown what widespread use was made of psychological tests during the period of the war. Tests were used to select fighting men, to classify them for their best employment, and to determine their best possible usefulness under fire. Certainly not fewer than ten million men in this country alone submitted to some sort of screening by psychological tests; and certainly the tests themselves operated overall at a level of predictive efficiency not hitherto achieved.

This is an accomplishment to which we psychologists may point with great pride. It is possibly the most important single contribution that applied psychology made to the very important and practical business of winning the war. Yet, while it is good, it is also revealing.

Consider the fact that our best-developed tests are probably tests of intelligence. We have made great advances, as a profession, over the intelligence tests used in World War I. A wealth of serious debate during the 1920's set the stage for the factor analysis surveys of the 1930's. We have as a result been able to learn much about the composition of intelligence. The typical intelligence test of the 1940's, partly as a result of such surveys, is a rather well-advanced tool. It contains a large percentage of discriminant items and affords a usefully broad range of scores, and it is characteristically high in reliability. As a result of correlational studies, we know a good deal about the relationship between intelligence test scores and progress in education, in industry, and in the military hierarchy.

Now all of this is good; but it is also significant for my thesis, for intelligence is perhaps the best-behaved, the least troublesome, and possibly the least modifiable of all our behavioral characteristics. It does not represent much of a social problem. The man in the street, without help from the psychologist, has pretty well figured out what to do about differing levels of intelligence. In the main the work of the psychologist has served only to confirm and justify the rule-of-thumb procedures which have been handed down as a part of our common-sense social inheritance. The work on intelligence testing has been well worth doing; but it has been accomplished while other and much more pressing social problems were thrust aside.

PERSONALITY TESTS

Let us consider some of the less well-behaved aspects of human behavior. Take that vague and undefined term 'personality.' In our everyday life it bulks as considerably more of a problem and as considerably more subject to modification and change than intelligence. Our ready-made social fabric is much less certain in telling us which individuals are wide of the average in their emotional and social adjustments. Indeed, a recently published best seller suggests that hundreds of thousands of people a year are taking their suspected personality troubles to countless varieties of quacks and charlatans. Clearly the situation demands that the psychologist, as rapidly as possible, shall develop tests which will accurately reflect how any given individual deviates from the social or emotional norm; and it demands that the psychologist shall indicate ways of reducing undesirably large deviations, if, indeed, modification is possible.

The problem has great social significance. What does organized psychology have to offer, in 1945, toward its solution? The plain answer is, very little indeed. Where the intelligence test of 1945 is a recent product, based on hundreds of careful researches, I am informed that the most widely used "personality" test at this time is one published in the early 1930's and based on work completed in the 1920's. Researches on this test have been few; and their outcome has been almost entirely negative. Attempts to validate it against available criteria have, so far as I am able to learn, yielded nothing to encourage us to believe that it gets at clinically identifiable aspects of behavior. Furthermore, such studies as have been made of the traits it purports to measure suggest that these alleged traits are in themselves so unstable as to limit the test to a uselessly low level of reliability.

One may well ask about some of the other attempts to get at personality, such as Murray's work, Shipley's Inventory, the Minnesota Multiphasic, and, above all, the work in projective tests. The answer is simply this: Granted that certain men are exploring promising angles, the vast bulk of American psychology has not advanced in its thinking about personality tests since the 1920's. If we are concerned with large-scale movements in the field, we can feel no elation over the explorations of the few. We shall not have met the social challenge of the need for personality-measuring instruments until psychologists in considerable numbers have sacrificed the professional gains of working neatly on further definitions of intelligence to work upon the unsolved, and possibly unsolvable, problems of defining the place of a given individual in the area of social and emotional adjustment.

Public Opinion Polls

The example just cited is by no means an isolated one. As you leaf through any year's issue of the *Psychological Abstracts*, you will be struck by the inevitability with which our profession in the main has chosen the neat, rather than the socially significant, in finding problems worthy of its researches. We have, for example, devoted much time and thought to improving the predictive efficiency of our public opinion polls; yet we have pretty consistently dodged the issue of trying to determine what effect the polls themselves may have upon the voters. Alarmed politicians may insist that the polls, by inducing a desire to climb on the band wagon, have seriously altered the political picture. In the main, our researchers have preferred to wave this charge off and to work on the improvement of their polling methods. And, as you review the situation, you may again be struck by the fact that the improvement of predictive efficiency is a neat, quantitatively expressible problem, while the measurement of band-wagon effects is unorthodox, complicated, and difficult of quantitative expression.

Education

In our public schools you will find many parallel illustrations. Researches of the past fifty years have brought out a wealth of information as to how to improve teaching. We can now, with some assurance, tell the teacher how to get better attention, how to assure lasting memory, how to motivate his students to work, and, in general, how to induce them to perform well on scientifically improved final examinations. These are all real gains; but they dodge the basic issue of what changes, if any, are produced in our students by their education. We cannot say, with even the slightest degree of scientific assurance, what any given course, or any given curriculum, contributes to the making of a wise and stable citizen. We are totally unable to say which courses make critically important contributions and which make negligible, or even negative, contributions. In other words, we who set high standards of validity for our predictive tests are totally without information as to the validity of any of the elements which make up our modern curricula.

Alcohol

The exhibit can be expanded endlessly, but here I shall include only a final example. We may begin by pointing out that we know a good deal about the primary effects of alcohol upon human behavior. This is scientifically interesting, and it is useful. Yet the social problem here is pretty well solved by our folkways. Society does not admit the judge to the bench or the teacher to the rostrum while in a primary state of intoxication. It penalizes heavily the drunken driver and the drunken aircraft pilot. In general, society at large recognizes that a man in a primary state of intoxication is incapable of wise and well-coordinated behavior. Our researches, it appears, do little more than confirm and quantify what the man in the street has known since the days of the Old Testament.

Turn from this to the state that *follows* intoxication and you have a different story. Society appears to be puzzled about what to do with the man who has a hangover. He is admitted, possibly with an admiring leer, to the bench or the schoolroom. He sits at the council table in the industrial establishment. He is permitted to drive his car or fly his plane. Yet through all this runs a thread of social uneasiness. We learn that certain commercial airlines take steps to prevent drinking within twenty-four hours of a scheduled flight. We hear of business executives who defer all decisions when they are admittedly recovering from overindulgence. The attitude of society, in other words, appears to be equivocal; it looks to science and technology to supply valid estimates of how, and how badly, a man's resources are reduced by the presence of a hangover.

Here is a socially significant problem, amusing though it may seem at first sight. How much have the research disciplines to say about it? Although there are literally thousands of articles reporting investigations into the primary effects of alcohol, there were, the last time I checked, exactly *three* research articles on the nature of the hangover. The fact that none of these three met the ordinary standards of sound research is irrelevant. The basic fact is that, on the equivocal problem of the hangover, research is silent; it has nothing to offer society. A major reason, I believe, is simply this: The study of the primary effects of drinking is neat; it promises early returns, based upon adequate use of controls, and leading to nicely quantitative results. The hangover is a messy topic. Controls are uncertain, and the outcome is likely to be something less than clear cut. Social scientists have turned, almost without exception, to the study of intoxication itself and have shied away from the socially important, but methodologically unpromising, study of the aftereffects.

If you doubt the fundamental thesis as given here, you may turn to any of the annual indices and make your own tabulation. It can scarcely fail to convince you that the social significance of a problem has been a determinant only for the few; the many have persistently devoted their research efforts to the methodologically neat, with a bland indifference as to whether the outcome met any social need or not.

You may be ready to object that, by raising this issue, I am striking at the very basis of sound research. You may object that the job of the investigator is to investigate and that, in science, no problem is any more important than any other. You may urge that investigating the effects of a one-degree rise of temperature on the maze-solving habits of the tapeworm is, by definition, just as important as the study of why men fight. If you do, it will be a familiar argument, for the speaker was raised on the concept of a science which mercilessly and objectively sought out its facts and let the chips—and the human race—fall wherever they might. He was raised on the stereotype of a scientist who had no social responsibility and who was motivated solely and entirely by the desire to discover the generalizations under which future occurrences might be predicted.

It is a picture not without some considerable appeal. It may have been quite adequate to the world of yesterday; but it has now lost its adequacy. That is not to say that the social scientist should not work upon problems which have no immediate and obvious application. He should and he will. Indeed, it is important that our research people should be left relatively free to work on such problems as their own consciences may direct, for only thus can science and technology progress.

APPLIED *vs.* PURE RESEARCH

At the same time, let us free our thinking from one error. There has long been in existence a vague belief that something called 'pure science' developed basic methods which it then handed over to 'applied science' for use in practical contexts. I am told that this is at best a partial truth in other sciences. I know that it is rarely true in psychology. A careful review of the last twenty years in applied psychology will show that many, if not most, of the methodological advances in applied psychology were made by men working directly in some practical context. This being the case, researchers can afford to devote much of their time to working on practical problems without any fear that the development of new and basic methodology will thereby cease.

It is encouraging to note that psychology at large has already had four valuable years of practice in working at problems of social significance. It is encouraging to note that this work has been sound enough to evoke the support of hard-headed military realists. One aspect of this situation is worthy of particular note. It is worthy of particular attention that men who were brought in to work upon very specific and highly localized technical problems found themselves increasingly assigned to tasks of greater complexity and greater significance. Men originally assigned to the improvement of selective tests gradually earned the right to work with whole systems of classification for combat assignments. In many cases work with relatively simple criteria based on outcome of training led over into the much more complicated, and more significant, evaluation of actual performance under fire. Psychologists originally assigned to improve the mechanics of day-to-day examinations finally were given a free hand in revising whole programs of training and, indeed, of redefining the whole purpose of the training program. As the detailed history of this war is published, the thoughtful reader will see that here, as never before, psychologists have progressed from an original attack on the neat and simple to a later and more prolonged concern with the militarily important and methodologically complex. It is the speaker's conviction that this will ultimately be regarded by our profession as the most significant development of the war for the future of psychology.

It is of the greatest importance that the lessons of the war shall not be lost. It is of the greatest importance that attitudes and techniques which proved to have real practical significance in attacking the primarily destructive social problems of the war shall be carried over for attacks on the primarily constructive social problems of peacetime. Yet this will be accomplished only if psychologists in general recognize how they have achieved their present military status and if they recognize why they must transfer their efforts and their zeal to the attack upon common social problems.

To this end, careful note must be made of one significant motivating influence of the wartime period. In the main, psychologists were not permitted to remain in their laboratories, or to work upon military problems in the comfortable isolation of their own campuses. Characteristically, they were transported bodily to the military establishment and compelled to live in day-to-day contact with military folk and military problems. As they sweated out tours of duty, they began to work upon certain problems—in a very large number of cases—simply because the problems forced themselves on their attention, day after day. Their problems, if you please, arose from the persistent demands of the environment rather than from the pressure of some systematic conviction or professional nicety. You will readily understand that the voice of the military environment became audible because the trained investigators were there in the military environment itself. If they had remained in their laboratories and in their studies, the voice of the military environment would have been, at best, muffled and not improbably distorted beyond recognition.

You have heard my thesis. I advance it with the greatest humility, not as a revelation of some novel truth but as an effort to formulate what everyone here must surely realize. You may well ask why I bother to state the thesis at such length, if everyone recognizes its existence. It is advanced as the formulation of one hypothesis which may serve to stimulate some proportion of this group to think beyond the hypothesis itself toward the solution of a basic problem. If such thinking should serve to negate the hypothesis I have advanced, well and good. The fate of the hypothesis is of infinitely less importance than that clear thinking should be done by those who are charged with socially significant researches. The war has given the profession of psychology its greatest forward impetus toward the achievement of a place of importance at those council tables where the future of mankind may well be decided. It is by the thinking of such folk as you who are assembled here that the effectiveness of these later councils will be determined. May you think well!

Scanning Science—

At the August meeting of the German Society of Anthropology, at Cassel, the opening address was by Dr. Waldeyer, of Berlin, on "the somatic differences of the two sexes." Its aim was particularly to bring out the contrasts between woman and man, with the purpose of applying the results to the education and "sphere" of woman. He argued that since a wide collation of measurements and statistics proves that she has a smaller brain, has less physical strength, preserves more traits of infancy and childhood in adult life, and has practically in all times and places held a position inferior to the man, that in our schemes of social improvement these undeniable facts should be respected. The efforts of social democrats and society leaders to establish entire equality between the two sexes and to throw open to woman all the avenues of activity enjoyed by man, he intimates, are mistaken, and will prove failures; and quotes with approval the opinion of Bartels, who maintains that the education, physical and mental, of woman, however high it may be, should be always aimed to fit her for the duties of the family circle only. This conclusion will not be in the least acceptable to the "advanced" women of the day, nor to those sociologists who see in woman's present condition, not the model of the future, but a survival from a barbaric past.

—3 *January 1896*

S. 1720

THE NEW SCIENCE BILL which was introduced into the Senate on 21 December 1945 was briefly analyzed in last week's issue (*Science*, 1946, **103**, 10–11). Using S. 1297 (the original Kilgore Bill) as little more than a point of departure, S. 1720 evolved from the October hearings sponsored by Senators Magnuson, Kilgore, and Fulbright. In the belief that the importance of the legislation requires scientists to be familiar with the details of the bill, the full text follows:

In the Senate of the United States

79th CONGRESS, 1st Session, 21 December 1945

Mr. Kilgore (for himself, Mr. Johnson of Colorado, Mr. Pepper, Mr. Fulbright, and Mr. Saltonstall) introduced the following bill, which was read twice and referred to the Committee on Military Affairs:

A bill to promote the progress of science and the useful arts, to secure the national defense, to advance the national health and welfare, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Science Foundation Act of 1945."

DECLARATION OF POLICY

SEC. 2. The Congress hereby finds that a full development and application of the Nation's scientific and technical resources is essential for the national defense, national prosperity, and the national health and welfare. The Congress declares it to be the purpose of this Act among other things to provide support for scientific research and scientific development, to enable young men and women of ability to receive scientific training, to promote the conservation and use of the natural resources of the Nation, to correlate the scientific research and development programs of the several Government agencies, to achieve a full dissemination of scientific information to the public, and to foster the interchange of scientific information in this country and abroad. The Congress further finds it essential for these purposes to create a central scientific agency within the Federal Government.

SEC. 3. (a) There is hereby established an independent agency of the Federal Government to be known as the National Science Foundation (hereinafter referred to as the "Foundation"), and administered by an Administrator (hereinafter referred to as the "Administrator") who shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at the rate of $15,000 per annum. The President shall appoint a Deputy Administrator, who shall perform the functions of the Administrator during his absence or when there is a vacancy in the office of the Administrator, and shall perform such other duties as may be delegated to him by the Administrator. The Deputy Administrator shall receive compensation at the rate of $12,000 per annum.

(b) There shall be within the Foundation a Division of Mathematical and Physical Sciences, a Division of Biological Sciences, a Division of Social Sciences, a Division of Health and Medical Sciences, a Division of National Defense, a Division of Engineering and Technology, a Division of Scientific Personnel and Education, a Division of Publications and Information, and such additional divisions, not to exceed three in number, as the Administrator may from time to time establish. The functions of each division shall be prescribed by the Administrator. Each division shall be headed by a Director, who shall be appointed by the Administrator and shall receive compensation at the rate of $12,000 per annum.

(c) Except as provided in section 4, the Administrator shall appoint and fix the compensation of such personnel as he may deem necessary to carry out the provisions of this Act. Such appointments shall be made and such compensation shall be fixed in accordance with the provisions of the civil-service laws and regulations and the Classification Act of 1923, as amended, except that, when deemed necessary by scientific, technical, and professional personnel may be employed without regard to the civil-service laws, and their compensation fixed without regard to the Classification Act of 1923, as amended.

NATIONAL SCIENCE BOARD AND DIVISIONAL SCIENTIFIC COMMITTEES

SEC. 4. (a) The Administrator, in exercising his authority under this Act, shall consult and advise with a National Science Board (hereinafter referred to as the "Board") and, through the Directors of the several divisions, with divisional scientific committees, on all matters of major policy or program or budget. The Board shall consist of nine members appointed by the President, by and with the advice and consent of the Senate, from among persons who are especially qualified to promote the broad objectives of this Act, plus the chairman of the several divisional scientific committees. The scientific committee for each division, except the Division of National Defense, shall consist of not less than five and not more than fifteen members appointed by the Administrator, with the approval of the Board, except that the initial members of each divisional scientific committee shall be appointed by the Administrator with the approval of the nine Board members appointed by the President.

The scientific committee for the Division of National Defense shall consist of not more than forty persons, of whom at least half shall be civilians appointed by the Administrator, and the remaining members shall be divided equally between such chiefs of services or divisions of the War Department and such chiefs of bureaus and offices of the Navy Department as the Secretary of War and the Secretary of the Navy, respectively, may from time to time designate. There shall be within the divisional scientific committee for the Division of National Defense a nine-man executive committee consisting of the chairmen of the divisional scientific committee, as chairman; four civilian members elected annually by the civilian members of the divisional scientific committee, together with two Army officers and two naval officers, one of each of whom should be charged in their respective Departments with the coordination of research, designated by the Secretary of War and the Secretary of the Navy, respectively.

Every effort shall be made to assure that each divisional scientific committee is representative of the major scientific interests and functions of its division. Members of the Board appointed by the President and members of the divisional scientific committees appointed by the Administrator shall serve for three-year terms, except that (1) at least one-third of such members originally appointed shall be appointed for one-year terms, and at least another third for two-year terms, and (2) any member appointed to fill a vacancy occurring prior to the expiration of the term of his predecessor shall be appointed for the remainder of such term.

No person who has served as a member of the Board or any divisional scientific committee shall be eligible again to serve as a member of the same group until the expiration of three years after his term has expired, except that a member appointed for a term of less than three years may be appointed for a succeeding three-year term.

(b) The Board and each divisional scientific committee shall annually elect its own chairman from among its own members, and shall deivse its own rules of procedure. The Board and each such committee shall meet at the call of its own chairman or at such times as may be fixed by itself, but in no event less frequently than once each month.

The Board shall appoint and prescribe the duties of an executive secretary of its own selection. The executive secretary, together with such clerical and professional assistance as may be determined by the Board to be necessary, shall assist the Board in carrying out its functions as described in this Act.

(c) The Board shall continuously survey the activities and management of the Foundation, and shall periodically evaluate the achievements of the Foundation in accomplishing the objectives of this Act. Each divisional scientific committee shall survey continuously the scientific field which it encompasses, shall undertake to determine the specific scientific needs of such field, and shall evaluate proposed programs and projects. The Board and each such committee shall, upon its own initiative or upon request by the Administrator, make appropriate recommendations and reports relating to its duties and findings. The Board and each such committee shall have full access to all information in the possession of the Foundation.

(d) The Board may, whenever it deems necessary, make such recommendations to the President and the Congress as in its opinion will further the objectives of this Act. The Administrator shall, whenever requested by the Board or any divisional scientific committee, publish and disseminate widely any recommendations or reports prepared by the Board or such committee. The Administrator shall render an annual report to the President and the Congress, summarizing the activities of the Foundation, together with such recommendations as he may deem appropriate. The annual report shall include such independent recommendations concerning the budget, the organization, and the management of the Foundation, and such other recommendations as the Board and the divisional scientific committees may deem necessary to better effectuate the purposes of this Act. The annual report shall include whatever dissenting opinions may be submitted for that purpose by individual members of the Board or the divisional scientific committees.

(e) Members of the Board and of the divisional scientific committees shall receive compensation at the rate of $50 for each day engaged in the business of the Foundation, and shall be reimbursed for their necessary travel and other expenses incurred in the work of the Board or of any such committee. Persons holding other offices in the executive branch of the Federal Government may serve as members of the Board or any divisional scientific committee, but they shall not receive remuneration for their services as such members during any period for which they receive compensation for their services in such other offices, nor shall they act in an official capacity for the Government agency by which they are employed while they are serving as members of the Board or such committee.

(f) Members of the Board and of any divisional scientific committee established under the provisions of this Act, and any other officers or employees of the Foundation, shall be chosen without regard to their political affiliations and solely on the basis of their demonstrated capacity to carry out the purposes of the Foundation and their fitness to perform the duties of their office.

(g) The Administrator may create such specialized additional advisory committees or employ the services of part-time advisory personnel as he may deem necessary to better effectuate the objectives of this Act. Persons so engaged shall be reimbursed for their necessary travel and other expenses incurred in the work of the Foundation. Such persons may be noncompensated or may receive compensation at the rate not to exceed $50 for each day of service. Any person serving only in an advisory capacity pursuant to this section, including the members of the National Science Board and of the Divisional Scientific Committees, may serve as such without regard to the provisions of sections 109 and 113 of the Criminal Code (18 U.S.C., secs. 198 and 203) or section 19 (c) of the Contract Settlement Act of 1944, except insofar as such sections may under certain conditions prohibit any such person from receiving compensation in respect of any particular matter which directly involves the Foundation or in which the Foundation is directly interested; but nothing in this Act shall be construed to modify, impair, or restrict the application of section 41 of the Criminal Code with respect to any such person.

SUPPORT OF RESEARCH AND DEVELOPMENT

SEC. 5. (a) The Administrator is authorized to enter into contracts or other arrangements pursuant to which he will finance, in whole or in part, or otherwise support, research and development activities to be carried on by other Government agencies or by other organizations.

(b) Of the funds appropriated to the Foundation and expended by it for research and development activities, not less than 15 per centum shall be expended for research and development in each of the following fields: (1) National defense and (2) health and the medical sciences.

(c) Of the funds appropriated to the Foundation for research and development activities (excluding funds expressly appropriated for national defense), not less than 25 per centum shall be apportioned among the States as follows: Two-fifths shall be apportioned among the States in equal shares, and the remainder shall be apportioned among the States in the proportion that their respective populations bear to the population of all the States, determined according to the last preceding decennial census; and the amounts so apportioned to each State shall be expended by the Administrator only for carrying on research and development activities in the facilities of tax-supported colleges and universities, including the land-grant colleges, within such State. In making contracts or other financial agreements pursuant to this provision, the Administrator shall, consistent with such general program as he may establish in order to carry out the objectives and provisions of this Act, give each individual institution the widest latitude in its choice of individual research and development projects. For purposes of this section the term "State" includes Alaska, Hawaii, and Puerto Rico. Of the funds appropriated to the Foundation for research and development activities (excluding funds expressly appropriated for national defense), an additional per centum of not less than 25 shall be expended in the facilities of nonprofit organizations without regard to the above limitations relating to State quotas or the tax-supported character of the organization. In meeting the requirements of this subsection, the Administrator may take into account whatever funds may be expended by the Foundation for facilities to be operated by the land-grant, tax-supported, or other nonprofit organizations, even though the title or ownership rights of such facilities remain with the United States.

(d) The activities of the Foundation shall be construed as supplementing and not superseding, curtailing, or limiting any of the functions or activities of other Government agencies authorized to engage in scientific research and development. Funds allocated by the Administrator to other Government agencies shall be utilized for projects approved by the Administrator and undertaken on behalf of the Foundation, and shall be in addition to, and not in lieu of, funds regularly appropriated to such other Government agencies.

(e) In all research and development activities financed or otherwise supported by the Foundation, the Administrator shall make every effort to eliminate restraints upon the free expression of scientific views and to insure full freedom in the exercise of creative talents, in the development of new ideas and in the methods of research. Any person engaged in such research and development activities shall not be precluded from discussing, writing, or publishing his own findings and conclusions irrespective of such other arrangements for publication and dissemination as may be made by the Administrator.

SCHOLARSHIPS AND FELLOWSHIPS

SEC. 6. The Administrator is authorized to award scholarships and fellowships to persons for scientific study or scientific work at nonprofit institutions of higher education, or other institutions, selected by the recipient of such aid, for such periods as the Administrator may determine, in the United States or in foreign countries. Persons shall be selected for such scholarships and fellowships solely on the basis of aptitude, within the limits of such State quotas as may be established to insure an equitable selection of such persons from among the States. Persons selected for such scholarships and fellowships may include employees of the Federal Government and such employees selected and detailed for scientific study or training shall not lose their individual status or seniority ratings for reason of absence from regularly assigned duties during the course of such study or training.

REGISTER OF SCIENTIFIC PERSONNEL

SEC. 7. The Administrator shall maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information concerning all scientific and technical personnel in the United States and its possessions. No individual shall be listed in such register without his consent.

USE AND DISSEMINATION OF RESEARCH FINDINGS

SEC. 8. (a) The Administrator shall make and maintain an inventory of all current federally financed research and development projects. In cooperation with the Commissioner of Patents, the Administrator shall establish a central register of all inventions, discoveries, patents, patent rights, and findings, including references to related data, in which the United States or any agency thereof has any right, title, or interest, or which pursuant to this section have been freely dedicated to the public. The Administrator shall record, collect, edit, index, publish, and disseminate significant data on all inventions and discoveries and other findings produced in the course of federally financed research and development activities, or arrange with other Government agencies for such recording, collecting, editing, indexing, publishing, and dissemination. In consultation and collaboration with the Library of Congress and other Government agencies, the Administrator shall take such steps as he may deem necessary to make such information and other available significant scientific and technical information accessible to the public, including the preparation and distribution of periodic catalogs, inventories, abstracts, translations, bibliographies, and microfilm reproductions, of research and development projects, contracts, reports, and publications. In the publication of such information, the Administrator may utilize private publishing facilities to the extent that he deems necessary or desirable, without regard to the provisions of section 87 of the Act of January 12, 1895 (28 Stat. 622), and section 11 of the Act of March 1, 1919 (40 Stat. 1270) (U. S. C., title 44, sec. 111).

(b) Each contract for federally financed research or development entered into between any Government agency and any organization shall provide that such organization will make available to such agency full data on all inventions, discoveries, patents, patent rights, processes, and findings produced in the course of such research or development, including such reports with respect thereto as may be required by such agency. Each Government agency, upon the request of the Administrator, shall make available to him such data and such reports with respect to research and development activities financed by such agency, as may be necessary for the purposes of subsection (a).

(c) Except as provided in subsection (d) below, all rights in inventions, discoveries, or patents now or hereafter owned by or vested in the United States or any Government agency shall be freely dedicated to the public, and any invention, discovery, patent, patent right, or finding hereafter produced in the course of federally financed research or development shall be freely dedicated to the public.

(d) The head of any Government agency financing by contract, or otherwise administering, federally financed research and development activities (including the Administrator in the case of the Foundation) may, by stipulation in the contract or by other advance agreement with any organization (other than a nonprofit organization), provide for the retention by the contractor or by the inventor, or by their assignees, of such patent rights as the head of such agency deems fair and equitable and consistent with the national interest: *Provided*, That—

(1) such retention is in a field specified in the contract and as to which field the head of such Government agency has made a formal finding, prior to entering into such contract or other advance agreement that such field has been developed substantially as the result of earlier research or development activities of the contractor which were not federally financed; or

(2) a later finding is made, pursuant to such procedures as may be specified in the contract or other advance agreement, that the particular invention, discovery, patent, patent right, process, or finding has been developed substantially as the result of earlier research or development activities of the contractor which were not federally financed; or

(3) the contractor or other recipient of financial assistance from the Government for research and development is currently contributing substantially to the cost of the particular research and development project.

In making any stipulation in a contract or other advance agreement pursuant to this subsection, the head of the Government agency shall, in determining what is deemed fair and equitable and in the national interest, be guided by the following principles: (1) That the Government's interest is served best by making fully available to all users at the lowest possible charge any invention, discovery, or finding which may result from such federally financed research or development; (2) that whenever there are two or more facilities of comparable suitability available to meet the Government's needs, the facility which requires no retention or least retention of commercial rights pursuant to this subsection shall be selected. Any contract or advance agreement made pursuant to this subsection shall in every case provide for at least an irrevocable, nonexclusive, royalty-free license for governmental purposes to the United States under all inventions, discoveries, patents, or findings produced in the course of the research and development contracted for.

(e) The head of each Government agency shall make a quarterly report to the President and to the Congress concerning contracts containing the provisions authorized by subsection (d), and shall include a list of all contracts containing such a provision entered into by such agency during the preceding quarter, the reasons supporting the approval of such provision in each case, the amount of Federal funds expended or to be expended under each contract containing such a provision, the name of the organization receiving the contract, and the general nature of the patent rights reserved for private use in each such contract.

(f) Notwithstanding any other provision of this Act, the President, or any person designated for that purpose by him, may exempt from the provisions of this Act relating to dedication to the public, publication, or dissemination, any scientific or technical information, data, patents, invention, or discoveries produced in the course of federally financed research or development, if and so long as the President or such designated person determines that such exemption is essential in the interest of national security.

INTERNATIONAL DEVELOPMENT OF SCIENCE AND INTERNATIONAL EXCHANGE OF SCIENTIFIC AND TECHNICAL INFORMATION

SEC. 9. (a) The Administrator is hereby authorized with the approval of and through the Department of State to conclude agreements with foreign governments or agencies thereof relating to the exchange of scientific and technical information to facilitate the maximum acquisition, dissemination, and use thereof. The Administrator may, whenever he deems it necessary to promote the objectives of this Act, defray the expenses of representatives of Government agencies and other organizations to accredit international scientific congresses and meetings.

(b) The Administrator is hereby authorized, with the approval of and through the Department of State, to cooperate in any international research or development activities consistent with the purposes or provisions of this Act and to allocate and expend for such international research activities, such sums, within the limit of appropriated funds, as the Administrator may deem desirable.

INTERDEPARTMENTAL COORDINATION

SEC. 10. (a) There is hereby established an Interdepartmental Committee on Science, to consist of the Administrator, as Chairman, and the heads (or their designees) of such Government agencies engaged in or concerned with the support of scientific activity to a substantial degree as the President may from time to time determine. The Interdepartmental Committee shall meet whenever the Chairman so determines, but not less than once a month.

(b) The Interdepartmental Committee shall advise and assist the Administrator in gathering and correlating data relating to the scientific research and development activities of the Federal Government; shall study and evaluate such data in relation to the program of the Foundation and the scientific research and development programs of the other Government agencies; and shall make such recommendations to the Foundation and other Government agencies and to the President as in the opinion of the Committee will serve to aid in effectuating the objectives of this Act and other legislation providing for Federal support of scientific research and development. The Administrator, in consultation with the Interdepartmental Committee, shall, from time to time, make recommendations to the President for the achievement of maximum effectiveness in the conduct of all federally financed research and development.

MISCELLANEOUS

SEC. 11. (a) To enable the Administrator to carry out his powers and duties, there is hereby authorized to be appropriated annually to the Foundation, out of any money in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this Act. The funds appropriated to the

Foundation, as herein authorized, and funds hereafter appropriated to any Government agency for scientific research or development, as herein defined, shall, if obligated during the fiscal year for which appropriated, or if reserved for a project expected to continue beyond the end of such year, remain available for expenditure for four years following the expiration of the fiscal year for which appropriated. After such a four-year period, the unexpended balances of appropriations shall be carried to the surplus fund and covered into the Treasury.

(b) The materials or equipment purchased by Federal funds or furnished by the Federal Government in connection with research and development activities shall be the property of the United States. The Administrator shall not, however, through the Foundation or its own employees, operate any laboratories, pilot plants, or other such scientific or technical facilities which he may acquire.

(c) In carrying out his functions under this Act, the Administrator is authorized—

(1) to prescribe such rules and regulations as he deems necessary governing the manner of the operations of the Foundation and its organization and personnel;

(2) to enter into contracts, or amendments or modifications of contracts, without performance or other bonds, and without regard to section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) in the case of all contracts which relate to scientific research or development;

(3) to make advance, progress, and other payments which relate to scientific research or development without regard to the provisions of section 3648 of the Revised Statutes (U. S. C., title 31, sec. 529);

(4) to acquire by purchase, or otherwise, hold and dispose of by sale, lease, loan, or otherwise, real and personal property of all kinds necessary for, or resulting from, scientific research or development;

(5) to prescribe, with the approval of the Comptroller General of the United States, the extent to which vouchers for funds expended under contracts for scientific research and development shall be subject to itemization or substantiation prior to payment, without regard to the limitations of other laws relating to the expenditure of public funds and accounting thereof.

(d) The following statutes, limiting the character and distribution of Government publications, attendance at scientific and professional conferences by Government employees, the purchase of literature by Government agencies, and related matters, shall not apply to the Foundation or, insofar as funds allotted by the Foundation may be used by any Government agency, to the use of such funds by any such agency: That cause of section 61 of the Act of January 12, 1895 (28 Stat. 601, 610; 44 U. S. C., sec. 71) reading: "but only one copy of any document shall be sold to the same person, excepting libraries or schools by which additional copies are desired for separate departments thereof, and Members of Congress"; section 92 of the Act of January 12, 1895 (28 Stat. 601, 623), as amended by section 8 of the Act of August 23, 1912 (37 Stat. 360, 414; 44 U. S. C., sec. 95); section 87 of the Act of January 12, 1895 (28 Stat. 601, 622), as amended by the second proviso of section 11 of the Act of March 1, 1919 (40 Stat. 1213, 1270; 44 U. S. C., sec. 111); that part of section 1 of the Act of March 3, 1905 (33 Stat. 1156, 1213), which is codified as Forty-fourth United States Code, section 118; section 94 of the Act of January 12, 1895 (28 Stat. 601, 623; 44 U. S. C., sec. 219); that part of section 1 of the Act of March 3, 1905 (33 Stat. 1214, 1249), which is codified as Forty-fourth United States Code, section 219a; the first proviso of section 11 of the Act of March 1, 1919 (40 Stat. 1213, 1270); section 8 of the Act of June 26, 1912 (37 Stat. 139, 184; 5 U. S. C., sec. 83); section 192 of the Revised Statutes, as amended (5 U. S. C. 102); and section 1779 of the Revised Statutes (5 U. S. C. 102).

DEFINITIONS

SEC. 12. As used in this Act—

(a) "Research and development" means theoretical analysis, exploration, and experimentation in any field of science (including but not limited to the mathematical, physical, biological, medical, and social sciences), and the extension of investigative findings and theories of a scientific or technical nature into practical application, including the experimental production and testing of models and processes.

(b) "Federally financed research and development" means research and development financed in whole or in part from funds designated for research and development by the Federal Government under a contract, grant, or other form of financial assistance.

(c) "Government agency" includes departments, independent agencies and commissions, corporations, and other instrumentalities of the Federal Government.

(d) "Organizations" includes State and local government agencies, corporations, partnerships, nonprofit institutions, and individuals.

(e) "Scholarships and fellowships" means stipends covering tuition and other fees, and such living, travel, and other expenses as the Administrator may determine.

Committee for a National Science Foundation

The text of a statement prepared by the Committee for a National Science Foundation appeared in these columns last week (*Science*, 1946, **103**, 11). The following list of names constituting the original signers is now available from the Committee, whose address is Room 170, Hotel Astor, New York City:

C. A. Adams, engineer, E. G. Budd Manufacturing Company, Philadelphia; Charles C. Adams, New York State Museum, Albany; C. R. Adams, professor of mathematics, Brown University; T. Addis, professor of medicine, Stanford Medical School, California; Harold L. Alden, Leander McCormick Observatory, University of Virginia; William Phelps Allis, professor of mathematical physics, Massachusetts Institute of Technology; I. Amdur, Department of Chemistry, Massachusetts Institute of Technology; Thomas F. Anderson, Johnson Foundation, University of Pennsylvania; Donald H. Andrews, professor of chemistry, Johns Hopkins University; Robert C. Angell, Department of Sociology, University of Michigan; Frank Aydelotte, Institute for Advanced Study, Princeton, New Jersey.

E. Wight Bakke, Institute of Human Relations, Yale University; C. Canby Balderston, Wharton School of Finance and Commerce, University of Pennsylvania; Edward Bartow, emeritus professor of chemistry, State University of Iowa; Charles H. Behre, Jr., professor of geology, Columbia University; Raphael A. Bendove, Columbia University Medical School; Ruth Benedict, professor of anthropology, Columbia University; Wendell C. Bennett, professor of archaeology, Yale University; Charles P. Berkey, emeritus professor of geology, Columbia University; Gordon W. Blackwell, Department of Sociology, North Carolina; David P. Boder, professor of psychology, Institute of Technology, Chicago; H. Dean Baker, Pupin Physics Laboratory, Columbia University; J. Lloyd Bohn, professor of physics, Temple University; Bart J. Bok, Harvard Observatory; Edison L. Bowers, Department of Economics, Ohio State University; Ernest W. Burgess, professor of sociology, University of Chicago; H. T. Briscoe, professor of chemistry, Indiana University; Allan M. Butler, Harvard Medical School.

Walter G. Cady, professor of physics, Wesleyan University; Frank K. Cameron, professor of chemistry, University of North Carolina; Leon Campbell, Harvard Observatory; Robert C. Challman, Division of Research, Norwich State Hospital; W. Edward Chamberlain, Department of Radiology, Temple University; Robert Chambers, professor of biology, New York University; Agnes Chase, Smithsonian Institution, Washington, D. C.; E. Chittenden, professor of mathematics, State University of Iowa; Richard G. Clarke, professor of chemistry, Wesleyan University; Charles H. Colvin, aeronautical engineer, 320 Central Park West, New York City; Edward G. Conklin, professor of zoology, Princeton University; Morris Llewellyn Cooke, Hay-Adams House, Washington, D. C.; John M. Cooper, professor of anthropology, Catholic University; Leonard S. Cottrell, Jr., Chairman, Department of Sociology and Anthropology, Cornell University; Richard Courant, professor of mathematics, New York University; E. V. Cowdry, professor of anatomy, Washington University Medical School; R. Tracy Crawford, professor of astronomy, University of California; Harry Curtis, Dean of Engineering, University of Missouri; Howard J. Curtis, Monsanto Chemical Company, Knoxville, Tennessee.

Leo M. Davidoff, Chief, Department of Surgery, Jewish Hospital, Brooklyn; Kenneth S. M. Davidson, Director, Experimental Towing Tank, Stevens Institute of Technology; M. Demerac, Carnegie Institution, Cold Spring Harbor, New York; Dr. Moses Diamond, embryologist, Columbia Dental School; Theodore Dobzhansky, professor of zoology, Columbia University; John Dollard, research associate, Institute of Human Relations, Yale University; L. C. Dunn, Department of Zoology, Columbia University; John R. Dunning, professor of physics, Columbia University.

A. Einstein, Institute for Advanced Study, Princeton, New Jersey; Robert Elman, professor of surgery, Washington University Medical School.

Kasimir Fajans, professor of chemistry, University of Michigan; I. Fankuchen, professor of physics, Brooklyn Polytechnic Institute; Marie Farnsworth, chemist, Metal and Thermit Corporation, Rahway, New Jersey; George E. Farrar, Jr., Temple University Medical School; Enrico Fermi, professor of physics, Nuclear Institute, University of Chicago; E. D. Friedman, 1192 Park Avenue, New York City.

A. L. Garbat, attending physician, Lenox Hill Hospital, New York City; Frederick J. Gaudet, Veterans Administration Guidance Center, Stevens Institute of Technology; John M. Gaus, professor of political science, University of Wisconsin; Samuel Gelfan, physiologist, 80 Haven Avenue, New York City; R. W. Gerard, professor of physiology, University of Chicago; James Gilluly, professor of geology, University of California at Los Angeles; Clarence H. Graham, professor of psychology, Columbia University; David M. Grayzel, pathologist, Jewish Hospital, Brooklyn; Harry Grundfest, Columbia University Medical School; Ralph H. Gundlach, professor of psychology, University of Washington; R. G. Gustavson, Vice-president, University of Chicago.

Danforth R. Hale, RCA Manufacturing Company, Harrison, New Jersey; Calvin S. Hall, professor of psychology, Western Reserve University; Robert B. Hall, professor of geography, University of Michigan; A. Irving Hallowell, professor of anthropology, Northwestern University; H. B. Hass, professor of chemistry, Purdue University; Ernst Hauser, professor of chemistry, Massachusetts Institute of Technology; Michael Heidelberger, Columbia University Medical School; C. Judson Herrick, professor of neurology, University of Chicago; Melville J. Herskovits, professor of anthropology, Northwestern University; Max Hertzman, professor of psychology, College of the City of New York; Joel H. Hildebrand, professor of chemistry, University of California; John Hill, Assistant Curator, American Museum of Natural History, New York City; T. R. Hogness, professor of chemistry, University of Chicago; Pryns Hopkins, Claremont College, Pasadena, California; Harold Hotelling, professor of economics, Columbia University; Maurice L. Huggins, research chemist, Eastman Kodak Company, Rochester, New York; W. S. Hunter, professor of psychology, Brown University; Harold Thomas Hyman, Monmouth Memorial Hospital, Long Branch, New Jersey.

Herbert R. Isenburger, Department of Physics, Columbia Uuiversity.

Preston E. James, professor of geography, University of Michigan; T. Duckett Jones, Harvard Medical School; Warren C. Johnson, professor of chemistry, University of Chicago.

John S. Karling, professor of botany, Columbia University; Joseph H. Keenan, professor of mechanical engineering, Massachusetts Institute of Technology; Foster Kennedy, professor of neurology, Cornell Medical College; Frederick G. Keyes, professor of chemistry, Massachusetts Institue of Technology; Paul Kirkpatrick, professor of physics, Stanford University; Morris Kline,

Continued on page 62

News and Notes

Dr. Doncaster G. Humm has been elected president of the Southern California Academy of Criminology, an organization founded about twenty-five years ago by August Vollmer.

Dr. G. W. Fox, professor of physics at Iowa State College, has been named technical adviser to Gen. Douglas MacArthur and probably will spend about three months in Japan. Dr. Fox, working with one other scientist, will advise Gen. MacArthur as to which scientific activities should be encouraged in Japan and which, if any, should be discouraged.

Dr. H. E. Hayward has been appointed director of the U. S. Regional Salinity Laboratory, Riverside, California, succeeding Dr. O. C. Magistad, who resigned to assume the direction of research for Libby, McNeill, & Libby in Hawaii. Dr. Hayward has been associated with the Salinity Laboratory since 1939, working on the salt tolerance of agricultural crops and the effect of saline substrates on the entry of water into roots.

Dr. Lloyd W. Morris, who recently returned to his post as professor of physics at Louisiana State University after three years war research on radar and proximity fuses, delivered an address before the Louisiana State Chapter of the Society of the Sigma Xi on 20 November. His subject was: "Can Pure Science Be Defended?"

Dr. Dexter French, research chemist at the Corn Products Refining Company, has been appointed research assistant professor of plant chemistry at Iowa State College.

Major John F. Sandfort, who has been on leave from the Department of Mechanical Engineering, has returned to his duties at Iowa State College.

Dr. C. Lee Huyck, formerly research chemist in charge of developing new products for the William S. Merrell Company, has recently joined the research staff of the Winthrop Chemical Company, Rensselaer, New York, in the capacity of senior pharmacist.

Lt. Col. William Reiner-Deutsch, Sn. C., lately executive officer of 191st General Hospital in Paris, has returned to the United States.

Dr. Ernest B. Benger, general assistant manager of the Technical Division of the Rayon Department of the Du Pont Company, has been appointed manager of the division, succeeding M. du Pont Lee, who was recently named general consultant in the Engineering Department, the company announced on 6 December 1945. A. E. Buchanan, Jr., continues in his present capacity as assistant manager of the Technical Division.

Dr. Robert L. Pendleton, technical consultant in soil science for the Office of Foreign Agricultural Relations, U. S. Department of Agriculture, has recently returned to Washington after ten months study of soils and land-use problems in Peru, Ecuador, the Canal Zone, Nicaragua, El Salvador, and Guatemala.

Dr. Robert E. Allen, who recently obtained his Ph.D. at the University of Illinois, has joined the Research Laboratories of The Wm. S. Merrell Company, Cincinnati, Ohio. Dr. Allen has been carrying out research work in the field of chemistry for the Office of Scientific Research and Development.

Announcements

Battelle Memorial Institute has announced that the release of its laboratories and staff from critical war research is being accompanied by a gradual resumption and expansion of its fundamental research. This type of research, which prior to the war always held a prominent place in Battelle's activities, is sponsored by the Institute itself as a public service and proceeds concurrently with industrially-sponsored work.

As in previous years, Battelle's fundamental research will be conducted both by members of the permanent staff and by specially-appointed research fellows. Fundamental investigations by its permanent staff are now in progress in the fields of physics, metallurgy, welding, and electrochemistry. Research fellows who have been appointed recently are conducting investigations in the fields of chemistry and electrochemistry.

Battelle fellowships are designed for graduates in the physical sciences who wish to pursue postgraduate work in preparation for careers in industrial and scientific research. By cooperative arrangement with participating universities, the fellow pursues academic work in a recognized graduate school and conducts his research for his thesis in the laboratories of the Institute. The problems investigated by Battelle fellows are, of course, problems in fundamental science.

A major fundamental research investigation undertaken by the Institute is the study of techniques for using the electron microscope in the examination of metallic and ceramic materials. A new RCA research model electron microscope was installed recently for use in this connection. The program is a long-range one, having as its objective the revealing of information which will widen the scope of usefulness of the electron microscope.

According to Director Clyde Williams, several years may be required for the full realization of the Institute's fundamental research plans. Much will depend on the manpower and equipment which can be made available for such studies. He also pointed out that many of the industrially-sponsored investigations at Battelle contribute directly to fundamental science. This is particularly true in the case of projects sponsored by research associations or groups of like industries banded together for the solution of problems basic to each industry. Quite often the solution to a strictly technological problem involves the solution of scientific problems underlying it.

The Pontifical Academy of Sciences has undertaken to compile a general report of the scientific research work accomplished throughout the world from 1939 to the present day. The Academy appeals, therefore, to its own members and to such scientists as are qualified to assist, asking them for their collaboration in this project, which ought to be carried through in the shortest possible time if it is to attain the object in view.

The general report will consist of a series of particular reports referring to one or more countries and will treat various branches of science, following a distribution normally to be determined by the best-known scientific journals or reports as selected by the author.

Each report should comply with the following rules: 1) It should be concerned with publications issued from 1 January 1939 up to the time of the report; 2) it should be preceded by a synthetic presentation of the situation of the scientific branch considered in the country or countries to which the study refers; 3) it should relate the most important results attained; and 4) it should include a bibliography of as many works as possible, properly classified, even if they do not refer to the researches described in the general part of the report.

Arrangements are being made for shipment of the material to Vatican City through the Apostolic Delegation in Washington, and men engaged in every field of scientific endeavor are asked not only to submit reports but also to send manuscripts and reprints of their publications, especially reviews, to Dr. Piero P. Foà, Chicago Medical School, 710 South Wolcott Avenue, Chicago, Illinois.

The Educational Committee of the National Bureau of Standards, in the course of its regular program of graduate instruction, announces the following courses for the present academic year: Electricity and Magnetism, Dr. Allen V. Astin; Differential Equations, Mr. Samuel Levy; Petrographic Methods, Dr. Willard H. Parsons; and Advanced Physical Chemistry, Dr. Walter J. Hamer. Each course comprises 60 lecture hours, and academic credit is given.

In addition, the two following symposia of 60 hours each are being presented this year, attendance at which is not subject to the usual academic regulations: Physical Methods in Chemical Analysis, under the direction of Dr. G. G. Manov; Properties of High Polymers, under the direction of Dr. R. Simha.

A number of active workers in the field from academic institutions and industrial laboratories in the country are participating as lecturers, together with members of the Bureau staff.

Paul Rosenberg Associates, consulting physicists, have announced the opening of offices in the Woolworth Building in New York City. Work will be done in radar, ultrasonics, television, optics, nuclear physics, and general physics. The head of the consulting firm, Paul Rosenberg, who before the war was lecturer in physics at Columbia University, has just completed four years war work with the Radiation Laboratory of the National Defense Research Committee at the Massachusetts Institute of Technology.

Journal of the History of Medicine and Allied Sciences, a new Quarterly published by Henry Schuman, 20 East 70th Street, New York 21, N. Y., appears this month under the editorship of Dr. George Rosen. The Editorial Board, in addition to Dr. Rosen, consists of Drs. Erwin H. Ackerknecht, Max H. Fisch, John F. Fulton, and Josiah C. Trent, and is to be assisted by forty-three consulting editors, approximately half of whom are located in various foreign countries.

The publisher states that the aims of the new Quarterly are: "(1) to help medical men better understand daily tasks through a knowledge of the history of the medical past, and (2) to provide cultural stimulation and pleasurable moments for those to whom medical history is a hobby and a joy."

The cost of an annual subscription is $7.50 in the United States, Canada, and Latin America, $8.50 elsewhere.

Conferences at the Hague are now taking place between Netherlands educators and scientists and the members of a delegation from the United States, which includes professors from leading colleges and Government experts as well as six U. S. Army officers. The American visitors were officially received at Amsterdam University by the Rector Magnificus and Feike de Boer, mayor of Amsterdam. Additional meetings will be held in Utrecht, Rotterdam, and other cities.

Technical Papers

Electrical Correlates of Peripheral Nerve Injury: A Preliminary Note[1]

R. G. Grenell and H. S. Burr
Yale University School of Medicine

In 1936 Burr, Lane, and Nims (*1*) described a new technic for the measurements of bioelectric phenomena. Their method was designed to discover whether or not living organisms possess potential differences, and, if so, to measure such differences independently of resistance changes and current flow. Further investigation showed that the apparatus met the ideal requirement, *i.e.* high input impedance (minimal current drain from the tissue), high stability, and high sensitivity. With this equipment available, the present experiments were undertaken to study potential differences of peripheral nerves (and of skin-surface areas) before and after injury and during degeneration and regeneration.

Three general types of experiments have been performed on rabbits and one on human cases, the sciatic nerve being used in all rabbit experiments and the ulnar nerve in the tests on human subjects: (1) direct measurements on peripheral nerve under various conditions; (2) measurements of limb surface EMF with the peripheral nerve undisturbed or blocked anatomically (nerve crushed or severed); and (3) measurements of limb surface EMF following physiological nerve block with procaine.

In all cases, measurements were made by means of the Burr-Lane-Nims microvoltmeter, described by them in 1936. Reversible, nonpolarizable, Ag-Ag Cl_2 brush electrodes were used, skin contact being assured by use of a salt electrode paste. The recorded data are in millivolts of potential difference between an indifferent electrode and an electrode moved from point to point along either a nerve or skin area.

In the first series of experiments, the sciatic nerve of the anesthetized rabbit was exposed in the thigh, and potential differences between an indifferent electrode on the skin of the leg and four selected points along the nerve proper were recorded. The second type of experiment involved similar measurements on the limb surface under normal conditions as well as following section or crushing of the nerve at the mid-point of the exposed area.

In the third series, rabbit sciatic nerves were infiltrated with 3 cc. of 4-per cent procaine without exposure of the nerve; in the human, ulnar nerves were infiltrated at the elbow with 3 cc. of 0.5- or 1-per cent procaine (in a few cases a procaine-adrenaline mixture was used). Records were made prior to injection, and following injection until the effects of the block had worn off.

The initial experiments in which measurements were made directly on the sciatic nerve in rabbits showed unequivocally that a potential gradient along the nerve is present. Distal points are negative to proximal. If the nerve is crushed so that the sheath is torn or traumatized, an injury potential is obtained (*i.e.* there is the expected peaking of the curve in the injured area).

Data obtained in the second type of experiment indicate that the potential differences recorded from the surface of the limb were modified by, or correlated with, the state of the peripheral nerve supplying the area. The acute effect of nerve section is a reversal in polarity of surface potentials.

These results led to an attempt to discover whether functional nerve block would be reflected in the surface measurements in a manner similar to physical or anatomical injury. In the rabbit, a series of six points on the skin, placed along the distribution of the sciatic nerve, showed a tendency toward significantly altered potentials following procaine injection of the nerve trunk. An hour following infiltration, many of these points showed a reversed polarity of considerable magnitude. This condition lasted for 45 minutes. Following this was a fall in potential until after the lapse of slightly more than two hours, when the potentials returned to approximately normal. This type of response is entirely absent when the degenerated sciatic nerve of the rabbit is infiltrated with procaine.

The results were so striking that a similar experiment was performed on human subjects. In these cases, three points were chosen along the hypothenar eminence lying within the area of distribution of the ulnar nerve. In the normal subject, as in the experimental animals, these three points show a marked shift in the measured potential difference.

In the case illustrated (Fig. 1), within 25 minutes after infiltration of the ulnar nerve with procaine, these three points were markedly positive. Twenty-five minutes later, with the return of flexor function, the potentials had dropped very considerably and continued to drop through the return of sensation and, after the lapse of three hours, had returned to their normal relationships. This can be clearly seen in Fig. 1. The polarities represented here are those of the moving electrode.

---

[1] The rabbits used in this study were provided in part under a contract recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Yale University School of Medicine. The study was aided by a grant from the Fluid Research Fund of the latter institution.

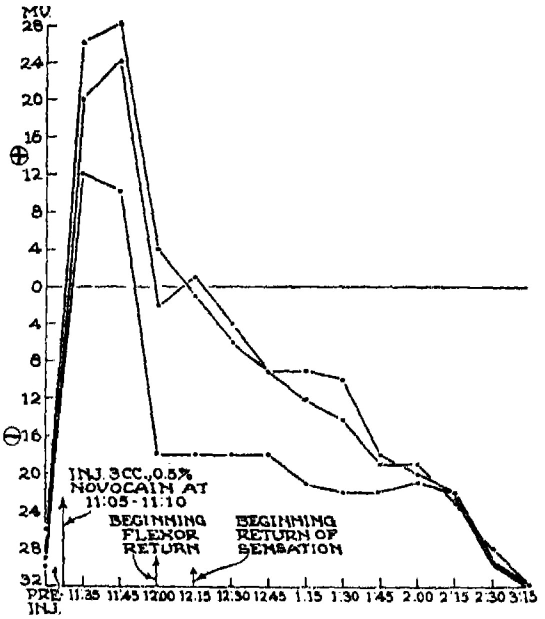


Fig. 1. Effects of left ulnar nerve block in man following injection of 3 cc. of 0.5-per cent novocain-suprarenin (1 : 50,000).

In man, procaine block produces changes of as much as 50–60 mv in the surface EMF of the functionally disturbed area. The curves in the human cases are much more striking than those of the rabbits, perhaps due in part to the fact that the rabbit nervous system was partially depressed, initially, by anesthesia.

It is clear from the results of these experiments that the condition of the peripheral nerve is reflected in the changing surface potential differences. The mechanism through which these changes are brought about is now being studied, and a clinical test for peripheral nerve injury is being developed.

Reference

1. Burr, H. S., Lane, T. C., and Nims, L. F. *Yale J. Biol. Med.*, 1936, **9**, 65–76.

Spinal Conditioning in Dogs

W. N. Kellogg, N. H. Pronko, and James Deese
Conditioning Laboratory, Indiana University

One of the most striking observations of recent years in the field of psychology and neurophysiology has been the observation that learning—or what appears to be learning of a rudimentary sort—can occur in the caudal extremities of higher vertebrates after the spinal cord has been completely transected. This would seem to mean that the organism, or a fragmentary part of it, can form simple associations without the aid of the cerebrum or of any of the higher centers of the central nervous system, and that these centers are therefore unnecessary for the occurrence of learning of the sort indicated.

The most extensive series of investigations on this topic has been conducted by Culler and Shurrager (*1, 2, 3, 4*), who used *acute* spinal dogs as experimental subjects. Their method was to pair an electric shock to the tail (the conditioned stimulus) with an electric shock to the foot (the unconditioned stimulus). Before training, the shocks to the tail produced no observable response in the flexing (semitendinosus) muscle of the leg; but after pairing of the conditioned and unconditioned stimuli, the tail shocks by themselves would then cause the semitendinosus muscle to contract.

We wish to report here some recent experiments at Indiana University in which conditioned-reflex training of a similar nature was attempted with *chronic* spinal dogs. A more complete account of the findings will appear subsequently in the psychological journals.

The conditioned stimulus in the present experiments was an electric shock to the left rear foot, and the unconditioned stimulus was a shock to the right rear foot. The response to be conditioned was the moving or flexing of the entire right hind limb. Each of the subjects was given 1,000 conditioning trials in groups of 100 trials each, spaced on alternate days over a period of about three weeks.

Despite the differences in experimental technique between the two investigations, there was clear evidence in each of our preparations that a muscle twitch or instantaneous jerk of the right rear leg could be evoked by the conditioned stimulus to the left rear foot. The twitch response was small in amplitude and of very short latency. We assume this twitching movement of the right rear member to be the same as the spinal conditioned response observed in the acute preparation by Shurrager and Culler.

The twitch response observed in our chronic spinal animals, however, was only a part of the behavior elicited by the conditioned stimulus. The records of movement of the right hind limb also disclosed a second and conflicting type of reaction. In place of the muscle twitch or incipient *flexion* there often occurred an *extension* of the right rear limb, *i.e.* the crossed extension reflex. Although the extension response was initiated immediately by the conditioned shock, it usually lasted for from two to three seconds. With respect to duration it had no resemblance, therefore, to the very brief jerk of the flexing muscles.

The two sorts of reflex movements were antagonistic and mutually inhibitory. They never occurred together on the same trial. One response would usually predominate for several trials and then be superseded by the other. Yet there can be no doubt that both responses were genuine and also that they were unstable (appearing and disappearing) even though the stimulating conditions remained the same.

Frequency graphs of the flexing twitch as well as of the extension response were so irregular that they were quite unrecognizable as learning curves. The only similarity to the typical curve of learning was that each response was absent at the start of training and increased somewhat in frequency during the later trials. When both the crossed extension and the flexion reactions were considered together, the combined frequency of responsiveness for all animals rose gradually for the first 300 trials (*ca.* one week) and continued at approximately 20 per cent responsiveness for the remaining 700 trials (*ca.* the two additional weeks).

In spite of this irregular level of about 20 per cent which persisted when both responses for all subjects were pooled, we could find no evidence of retention, over the intervals between experimental sessions, in the behavior of any one individual considered by itself. It should be clear, moreover, that the spinal behavior of the present subjects cannot be satisfactorily fitted into the conditioning formula, since that behavior was a combination of two antagonistic responses, now one occurring, now the other.

The conclusion to be drawn from these results is certainly not that spinal conditioning must be some sort of an artifact, but simply that we have not been able to establish it in chronic spinal animals under the conditions of the present experiments. The fluctuating responses of our preparations seem to us to be more adequately described as temporary changes in reflex behavior.

References

1. Culler, E. A. *Psychol. Bull.*, 1937, **34**, 742.
2. Shurrager, P. S., and Culler, E. A. *Amer. J. Physiol.*, 1938, **123**, 186.
3. Shurrager, P. S., and Culler, E. A. *Amer. J. Physiol.*, 1939, **126**, 630.
4. Shurrager, P. S., and Culler, E. A. *J. exp. Psychol.*, 1940, **26**, 183.

A Gastric Mucigogue Action of the Alkyl Sulfates

Harry Shay, S. A. Komarov, H. Siplet, and Samuel S. Fels

Medical Research Laboratory, Samuel S. Fels Fund, Philadelphia

The continued introduction of new remedies for the management of gastric and duodenal ulcer is sufficient evidence that the last word on such remedies has not been written. In the past the problem has been concerned chiefly with the effect of the extrinsic agent upon gastric acidity and to a less extent with its effect on peptic activity. Certain of the detergents have recently attracted attention on account of their antipeptic action. The present studies supply the first evidence that these detergents can stimulate an intrinsic gastric mechanism—secretion of mucus—which serves to protect the mucosa, mechanically, by its antacid effect, as well as to enhance any antipeptic activity which the agent itself might possess.

In a recent series of articles Shoch and Fogelson (*8*) reported that sodium alkyl sulfate inactivates pepsin *in vitro* without altering the pH of the solution; that it does the same *in vivo* (*9*) and, when administered to dogs with gastric ulcers produced experimentally by histamine, prolongs their lives considerably (*9*); and that it gave strikingly good clinical results in patients whose ulcers appeared to be intractable under other forms of therapy (*2*). The *in vitro* effects of these agents have been confirmed by others (*4*) and by ourselves. Regarding the *in vivo* effect, no such uniformity of results has been reported. Kirsner and Wolff (*5*), as well as Steigmann and Marks (*10*), failed to obtain the beneficial clinical results described by Fogelson and Shoch.

On administering to rats either of two highly purified products,[1] sodium dodecyl sulfate (C_{12}) and sodium "Lorol" sulfate (a mixture of C_{12} chiefly, plus some C_{14} and C_{16}), we observed in many of the animals a copious gastric secretion which appeared to be very rich in mucus. These results will be reported elsewhere. In view of the importance of mucus and its specific component, mucin, in protecting the gastric mucous membrane from destruction (ulceration) by the gastric juice, we were especially interested in the mucigogue action of the aforementioned agents. To determine whether these agents acted similarly in other animal species and also to obtain adequate quantities of mucus for study, we conducted experiments on dogs, the results of which form the substance of this report.

In fasting dogs under nembutal anesthesia, the stomach was isolated by ligation of the esophagus in the neck in conjunction with ligation of the pylorus either alone or with the addition of a ligature around the antrofundal juncture, according to a technique previously described (*6*). The latter procedure established a pyloric and a main stomach compartment. The whole stomach or the compartments were fistulized, as the case might be. The whole stomach or the pouches were lavaged thoroughly with saline at 38° C. until the last lavage returned clear (2 to 4 lavages). The gastric contents were then allowed to drain and, when the secreted material was represented only by alkaline mucus, a control specimen of an hour's secretion was then collected, in 15-minute fractions for the dodecyl sulfate or sodium "Lorol" sulfate in saline or distilled water, warmed to body temperature, was then introduced slowly through the fistula. The quantity introduced was sufficient to fill the whole stomach or pouch at a pressure of 5 to 6 cm. of water. The test agent was allowed to remain in the stomach at this pressure for 1 to 1.5 hour. The gastric contents were drained completely, and the gastric secretion was collected. A 2-per cent solution of sodium first hour and subsequently in 30- or 60-minute fractions for an additional 2 or 3 hours. The specimens were analyzed for mucin by two methods[2] (gravimetric and colorimetric) developed in our laboratory. Since the gastric secretion following the introduction of the alkyl sulfates was always alkaline, the alkalinity was determined—by acidification, followed by removal of CO_2 and back titration with alkali. Pepsin was determined by Nierenstein's and Schiff's modification (*7*) of Mett's method; and pH was determined colorimetrically and, when possible, with the glass electrode, using the Beckman pH meter.

---

[1] Supplied through the courtesy of Dr. J. H. Shipp, Fine Chemicals Division, E. I. du Pont de Nemours Company.

In the evaluation of the effects of the sodium alkyl sulfates upon gastric secretory function, two phases can be distinguished: (1) immediate effect, as reflected in the composition and physical properties of the instilled solution while in the stomach; (2) aftereffect, as manifested by the secretory response of the mucous membrane after the stomach is emptied.

The volume of fluid recovered from the stomach after 1 to 1.5 hour was never greater than the volume of fluid instilled. On the contrary, when the instillate was an aqueous (hypotonic) solution of the detergent, a small decrease (about 7 per cent) in the volume of the gastric contents was actually observed. Although the aqueous alkyl sulfate solution, when introduced into the stomach, contained no chloride, the gastric contents recovered contained a considerable amount (e.g. 38.9 m.eq. for the experiment illustrated in Fig. 1). They were quite viscous and contained much mucin (0.21 per cent).

The volume of mucus secreted during this period could not be determined directly but could be calculated. If we assume that the mucus secreted during the period in which the alkyl sulfate solution was in the stomach had the same concentration of glucuronic acid derivatives as that secreted for the second hourly period following the withdrawal of the test solution, the volume of mucus added to the instillate by the stomach mucosa was fairly large (e.g. for Dog 4 in the experiment illustrated in Fig. 1, 25.5 cc.). Similar calculations on the assumption that the chloride concentrations of the two specimens were equal would lead to erroneous values for the volume of mucus added by the stomach (e.g. for Dog 4 in the experiment illustrated in Fig. 1, 86 cc.).

The results of such calculations are, however, of value in other respects. Teorell (*11*) views the gastric mucosa as a dialyzing membrane which is permeable to sodium chloride among other substances. These data offer impressive evidence that the chloride added by the stomach to the alkyl sulfate solutions is only partly the result of an actual secretion of chloride with the mucus, being derived to a greater extent from tissue fluid (blood) by diffusion. Furthermore, since the chloride addition is accompanied by an actual decrease in the volume of solution introduced into the stomach, a corresponding and quite considerable amount of water must have been absorbed. These results are of especial interest, since the problems of the absorption by, and diffusion through, the gastric mucosa are still moot questions in gastric physiology.

The effect of the alkyl sulfates on gastric secretion is not limited to the period of contact with the mucosa. After the withdrawal of the agent the secretion of mucus continues at a very high, although gradually diminishing, rate for several hours.

Fig. 1 shows data of the rate of secretion of mucus and the output of mucin for a representative experiment. Our other experiments gave strikingly similar results. According to Babkin and his associates (*1*), rhythmic stimulation of the vagi with a weak current is a rather specific stimulus for the secretion of mucus. Babkin selected one of Vineberg's experiments (*12*) as representative of such an effect in the dog. When we calculated from Vineberg's table the volume of secretion per hour per kilogram body weight (results incorporated in Fig. 1), on which basis we calculated our own data, the

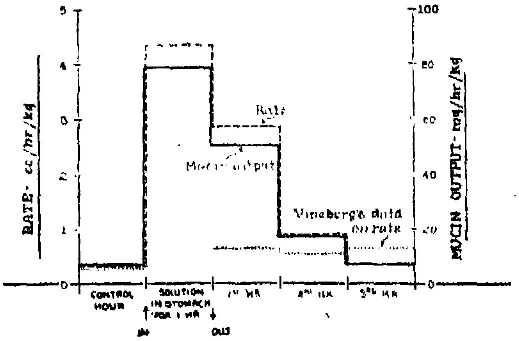


FIG. 1. Mucous secretion of Dog 4 (female; weight, 7 kg.; nembutal anesthesia; esophagus and pylorus tied; gastric fistula; stomach filled with 2-per cent aqueous sodium dodecyl sulfate for 1 hour).

---

[2] To be reported.

mucigogue effect of the agents we employed was found to be much greater than that of such a powerful stimulant as rhythmic stimulation of the vagi.

The mechanism for the stimulation of mucus secretion by the alkyl sulfates appears to be mainly, if not exclusively, a local one. The introduction of a 2-per cent solution of the alkyl sulfates into an isolated pyloric pouch in a dog under anesthesia was without effect upon the secretion of mucus from the body of the stomach. Furthermore, mucus secretion stimulated by these agents was not appreciably influenced by atropinization of the animal.

TABLE 1

COMPOSITION OF GASTRIC SECRETION IN RESPONSE TO 2-PER CENT AQUEOUS SODIUM ALKYL SULFATE

Alkyl sulfate	*No. of* samples	Chloride *m.eq./liter*		*No. of* samples	pH		*No. of* samples	Alkalinity *m.eq./liter*	
		Range	Mean		Range	Method		Range	Mean
Sodium dodecyl sulfate	16	95–134	118	20	7.5 –8.7	Color.	9	28–37	29
				5	8.27–8.42	Electro.			
Sodium "Lorol" sulfate	6	95–127	115	7	7.1 –8.6	Color.	5	27–31	30

The mucus secreted under the influence of the alkyl sulfates has physical and chemical properties very similar to those described in the literature as most representative of pure gastric mucus. This mucus appears as one of two types: one, opaque and so viscous that, in handling, it could only be divided by cutting with scissors; the other, clear, gelatinous and quite viscous, but still fluid enough to flow, though with great difficulty, through a small glass cannula.

The analytical data (Table 1) for chloride, alkalinity, and pH values of the mucus secreted are in good agreement with those reported by Vineberg (*12*) and by Hollander (*3*). We consider the action of the alkyl sulfates, in the concentration studied, upon the gastric mucosa to be quite selective and limited to the mucous cells, since the pH and chloride values of all specimens were typical for pure mucous and only the merest traces of peptic activity were seen in a few.

The samples of mucus obtained by the use of sodium dodecyl sulfate were found on microscopic examination to contain only a few cellular elements—single leucocytes and columnar cells in various stages of disintegration. These are considered normal constituents of mucus. Careful gross examination of the gastric mucosa immediately after the completion of the experiment showed only an active physiological hyperemia after the use of sodium dodecyl sulfate. However, after the use of sodium "Lorol" sulfate the gastric mucosa displayed areas the condition of which no longer could be considered as a response within the limits of physiological stimulation. Comparing our results with those recently reported by Hollander (*3*) for a variety of mucus stimulants, sodium dodecyl sulfate appears at this stage of the investigation to be the most innocuous stimulant of gastric mucus secretion.

Evidence is accumulating to show that a constantly renewed layer of mucus is the chief agent which protects the mucous membrane of the stomach from digestion by such a highly destructive agent as active gastric juice. Any breakdown of this mechanism will contribute to the development of ulceration. An agent specifically stimulating mucus secretion should, therefore, enhance such a protective mechanism. If we consider that in addition to their mucigogue property the alkyl sulfates also have the ability to inactivate pepsin under certain conditions, these agents appear to have promise for the treatment of "peptic" ulcers, provided conditions of administration can be devised to permit effective action of the drug.

References

1. BARKIN, B. P. *Secretory mechanism of the digestive glands.* New York: P. B. Hoeber, 1944. Pp. 202 ff.
2. FOGELSON, S. J., and SHOCH, D. *J. Amer. med. Ass.*, 1944, **73**, 212.
3. HOLLANDER, F. *Gastroenterology*, 1944, **3**, 403.
4. KIRSNER, J. B., and WOLFF, R. A. *Proc. Soc. exp. Biol. Med.*, 1943, **54**, 11.
5. KIRSNER, J. B., and WOLFF, R. A. *Gastroenterology*, 1944, **2**, 98.
6. KOLM, R., KOMAROV, S. A., and SHAY, H. *Gastroenterology*, in press.
7. NIERENSTEIN, E., and SCHIFF, A. *Arch. Verdauungskr.*, 1902, **9**, 559.
8. SHOCH, D., and FOGELSON, S. J. *Proc. Soc. exp. Biol. Med.*, 1942, **50**, 304.
9. SHOCH, D., and FOGELSON, S. J. *Quart. Bull. Northwestern Univ. med. Sch.*, 1942, **16**, 142.
10. STEIGMANN, F., and MARKS, A. R. *Amer. J. digest. Dis. Nutrition*, 1944, **11**, 178.
11. TEORELL, T. *J. gen. Physiol.*, 1939, **23**, 263.
12. VINEBERG, A. M. *Amer. J. Physiol.*, 1931, **96**, 363.

Degradation of Streptomycin and the Structure of Streptidine and Streptamine

H. E. Carter, R. K. Clark, Jr., S. R. Dickman,
Y. H. Loo, J. S. Meek, P. S. Skell,
and W A. Strong

Noyes Laboratory of Chemistry
University of Illinois, Urbana

J. T. Alberi, Q. R. Bartz, S. B. Binkley, H. M. Crooks, Jr., I. R. Hooper, and M. C. Rebstock

Research Laboratories
Parke, Davis and Company, Detroit

Brink, *et al.* (*1*) recently described the degradation of streptomycin into two basic fractions which they designated as streptidine and streptobiosamine. Information concerning the composition of streptobiosamine and its derivatives was presented, and the empirical formula of streptidine was given. Similar work has been in progress in our laboratories, the results of which closely parallel those reported. The purpose of this communication is to present certain of these data with especial reference to the structure of the streptidine.

Streptomycin hydrochloride (*2*) is completely inactivated on standing 24 hours in anhydrous 1.0 N methanolic hydrogen chloride without forming a new basic group. The addition of two volumes of ether completely precipitates the guanidine, which we previously reported (*2*) as one of the functional groups of streptomycin. From the supernatant solution there is readily obtained an amorphous, optically active hydrochloride of a nonguanidine base whose properties agree with those of "methyl streptobiosaminide dimethyl acetal hydrochloride" (*1*).

Addition of picric or sulfuric acid to an aqueous solution of the guanidine hydrochloride gives an insoluble crystalline picrate or sulfate. These salts are readily recrystallized from hot water.

Guanidine picrate: m.p. 271–273°. *Anal.* Calcd. for $C_8H_{18}N_6O_4 \cdot 2C_6H_3N_3O_7$: C, 33.34; H, 3.36; N, 23.33. Found: C, 33.33; H, 3.60; N, 23.50.

Guanidine sulfate: Dec. ca. 310°. *Anal.* Calcd. for $C_8H_{18}N_6O_4 \cdot H_2SO_4 \cdot H_2O$: C, 25.40; H, 5.82; N, 22.20; S, 8.45. Found: C, 25.43, 25.75; H, 5.63, 5.86; N, 22.20, (Micro Dumas), 0.0 (Van Slyke amino nitrogen); S, 8.57, 8.30.

Guanidine hydrochloride: Obtained by dissolving the picrate in methanolic hydrogen chloride and adding ether. *Anal.* Calcd. for $C_8H_{18}N_6O_4 \cdot 2HCl$: C, 28.66; H, 5.97; N, 25.08; Cl, 21.19. Found: C, 29.10; H, 6.23; N, 24.20; Cl, 20.80.

These analytical data agree best for salts of a diguanidine base of the composition $C_8H_{18}N_6O_4$. This compound has the same empirical formula as that suggested by Brink, *et al.* (*1*) for streptidine, and, although there are no confirmatory data, we presume they are identical.

Streptidine sulfate is also obtained in excellent yield by allowing a solution of streptomycin chloride in 1 N sulfuric acid to stand at 37° for 45 hours. The sulfate is precipitated in nicely crystalline form by adding three to five volumes of acetone to the reaction mixture.

Streptidine is hydrolyzed by refluxing for 48 hours with 6 N alkali yielding four moles of ammonia and a new base, for which we propose the name streptamine. This base is readily isolated as the slightly soluble sulfate by neutralizing the hydrolysis mixture with sulfuric acid and adding an equal volume of methanol. The sulfate thus obtained is purified by recrystallization from aqueous methanol.

Streptamine sulfate: Dec. ca. 340°. *Anal.* Calcd. for $C_6H_{14}N_2O_4 \cdot H_2SO_4$: C, 26.10; H, 5.83; N, 10.13; S, 11.60. Found: C, 26.67; H, 6.10; N, 9.91 (Micro Dumas), 10.03 (Van Slyke amino nitrogen); S, 11.55.

The hydrolysis of streptidine evidently proceeds as shown in the following equation:

$$\underset{\text{Streptidine}}{C_8H_{18}N_6O_4} + 4H_2O \rightarrow \underset{\text{Streptamine}}{C_6H_{14}N_2O_4} + 4NH_3 + 2CO_2$$

These results, coupled with titration data and the Sakaguchi test, establish with some certainty that the six nitrogen atoms of streptidine are present as two monosubstituted guanidine groups which are replaced by two primary amino groups in streptamine.

Streptamine is converted into a mixture of polybenzoyl derivatives by the Schotten-Baumann procedure. Further treatment with benzoyl chloride in pyridine yields a product melting at 350–351°, the analyses of which agree fairly well for hexabenzoylstreptamine.

Anal. Calcd. for $C_{48}H_{38}N_2O_{10}$: C, 71.79; H, 4.77; N, 3.49. Found: C, 71.02; H, 4.94; N, 3.55.

Hexabenzoylstreptamine is converted into N,N-dibenzoylstreptamine by refluxing with 0.5 N methanolic sodium hydroxide. The N,N-dibenzoyl derivative melts at 276–277° and gives a negative ester test.

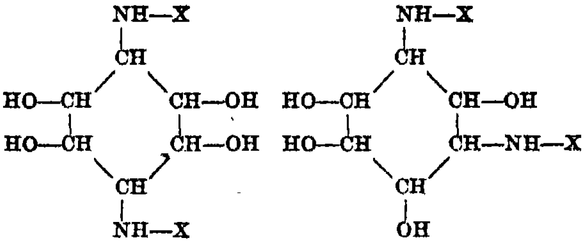
Anal. Calcd. for $C_{20}H_{22}N_2O_6$: C, 62.14; H, 5.75; N, 7.25. Found: C, 60.05, 60.64; H, 5.78, 6.05; N, 6.93, 7.20 (Micro Dumas), 0.0 (Van Slyke amino nitrogen).

Hexa-acetylstreptamine is produced by heating streptamine sulfate with sodium acetate and acetic anhydride, the crude product being purified by sublimation under reduced pressure. Hexa-acetylstreptamine is relatively insoluble in organic solvents and sublimes below 350° when heated on a hot stage.

Anal. Calcd. for $C_{18}H_{26}N_2O_{10}$: C, 50.23; H, 6.09; N, 6.51. Found: C, 50.18; H, 6.20; N, 6.66.

Periodate oxidation of streptidine, streptamine, and their derivatives: Since these substances are polyhydroxy compounds, a study of their behavior toward periodate seemed promising. As a model compound guanidoethanol sulfate was investigated. In contrast to ethanolamine, the guanidine derivative did not reduce periodate at pH 2–7. Streptidine reduced two moles of periodate; streptamine, six; dibenzoylstreptamine, two. No formaldehyde was formed from any of these compounds.

The fact that streptamine requires six moles of periodate indicates that the four hydroxyl and two amino groups are located on adjacent carbon atoms. The absence of formaldehyde production and the utilization of six moles of periodate both strongly point to a cyclic structure, since an open chain molecule should yield at least two moles of formaldehyde and require only five moles of periodate. On the basis of these results and the analytical data, streptamine is best formulated as a diaminotetrahydroxycyclohexane. Of the three possible arrangements of the amino groups (1,2; 1,3; 1,4) the 1,2-isomer is excluded by virtue of the fact that streptidine and N,N-dibenzoylstreptamine consume only two moles of periodate, whereas the 1,2-compound would use three moles. Streptidine and streptamine may be provisionally assigned one of the two following formulae:



Streptamine $X = H$

Streptidine $X = -C\begin{smallmatrix}=NH\\ -NH_2\end{smallmatrix}$

The isolation of the products resulting from the periodate oxidations is in progress and should distinguish between these possibilities.

References

1. BRINK, NORMAN G., KUEHL, FREDERICK A., JR., and FOLKERS, KARL. *Science*, 1945, **102**, 506–507.
2. CARTER, H. E., CLARK, R. K., JR., DICKMAN, S. R., LOO, Y. H., SKELL, P. S., and STRONG, W. A. *J. biol. Chem.*, 1945, **160**, 837.

Scanning Science—

Helmholtz, Hertz, and Kundt, the three greatest physicists of modern Germany, have died within two years, and the friends of German science feared that this loss would be followed by a standstill in physics, or at least by a lack of really important discoveries. But now we have Professor W. Röntgen's investigations in the physical laboratory of the University in Würzburg, the importance of which does not stand behind the famous electrical discoveries of Hertz in Bonn. Röntgen has found a new kind of rays—he calls them the X-rays—which though invisible to the eye, affect the photographic plate; which produce fluorescent phenomena; which pass through wood, metal and the human body; which are neither broken by prism and lenses nor reflected.

The chief facts about the X-rays are the following: It is well known that the discharges of a large Ruhmkorff induction coil produce in a vacuum tube, such as Crookes' or Hittorf's, colored rays which go in straight lines from the cathode to the glass of the tube. These cathode rays, which have been much studied, are visible to the eye and are well characterized by the fact that the magnet changes their direction; they do not pass thick cardboard, wood, etc. The place where these cathode rays reach the glass of the tube is the centre of Röntgen's X-rays. They are not visible and are not turned aside by a magnet; in short, they are not cathode rays, but are produced by them. Prisms and lenses do not diffract the rays, nor do prisms of hard rubber or aluminum. Lenses do not refract the rays and therefore ordinary photography is not possible; the pictures of the objects are only shadows. But these shadow-pictures can be taken in the closed window box of the camera in a light room, as the sunlight of course does not pass through the wood while the X-rays do. In this way Röntgen took photographs of a set of metal weights in a wooden box and of a thick wire wound as a spiral around a wooden stick; the wood was pervious, the metal of that thickness not, and so the shadows of the weights and of the wire are seen in the photograph, those of the wood scarcely at all. In the same manner he took the picture of a compass needle in the closed box. The door between two rooms did not hinder the chemical effect.

With regard to the nature of the X-rays it seems too early to say anything definite. Röntgen emphasizes the fact that they show no refraction and probably therefore move in all substances with equal velocity and are transmitted by a medium which exists everywhere and in which are the molecules of the substances.

—31 January 1896

In the Laboratory

A Photographic Method for Recording Ureteral Kinetics in Situ

D. R. Peterson
University of Oregon Medical School

A device for recording ureteral kinetics in situ has been described by Trattner (*3*). During a series of experiments on dogs using a similar apparatus, several undesirable features became apparent. A membrane tambour yields a tracing which is approximately a logarithmic function of the pressure applied; therefore, the sensitivity is reduced appreciably when working with increasing pressures. The elasticity of a membrane exerts a similar effect on fluid displacements so that successive increments or decrements of liquid are not recorded isometrically. The fling of a lever arm further adds to the inaccuracy of the method. Friction of the writing style on a smoked drum became perceptible when working with small animals. The purpose of this paper is to describe a recording unit to replace the membrane tambour with its lever and writing style.

Fig. 1 shows schematically the construction of such a unit, which consists of a small test tube to which two soft-glass tubes of about a 2-mm. bore are affixed. These serve as inflow and outflow conduits, respectively. As in Trattner's apparatus, the outflow orifice is constricted so that the ureter is working against a resistance which can be altered at will by using different-sized hypodermic needles, or an aperture of constant bore connected by a rubber tube a few centimeters long so that it can be raised or lowered. Valves are placed at strategic points to facilitate expulsion of air bubbles so that an all-liquid system can be realized. The principle of this unit is based on Pascal's Law, which states that pressure exerted at any point upon a confined liquid is transmitted undiminished in all directions. A rubber stopper in the open end of the test tube supports a 1-mm., even-bore, soft-glass tube of convenient length which serves as a manometer. Such a small-caliber manometer allows measurement of 1 cmm. or less of liquid displacement. The stopper is designed with a depression in the bottom so that a valve for releasing air bubbles from the manometer well (test-tube section) can be incorporated in the unit. The manometer well contains bromobenzene (phenyl bromide), this compound being chosen because it has a density of 1.4991 (*1*) and a surface tension of about one-third that of water; furthermore, it is immiscible with water (0.0446 grams are soluble in 100 cc. of water at room temperature).

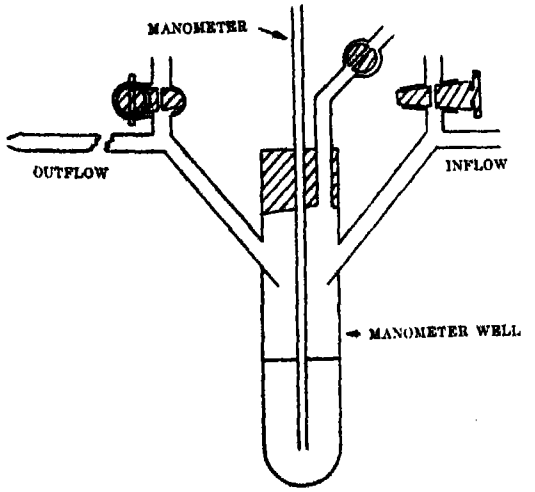


Fig. 1.

An excellent method for recording the excursions of a liquid in a manometer photographically has been reported by Kirchhof and David (*2*). However, a method which has been found suitable is to saturate bromobenzene with methyl red. This solution is photographically opaque to bromide paper and will cast a shadow when the manometer is juxtaposed to a thin slit in a light-tight box and adequate illumination is provided. For this purpose a 500-watt, clear glass tungsten bulb is satisfactory. To obtain a continuous tracing the bromide paper is fastened to a kymograph drum within the box with scotch tape. A record secured in this fashion is shown in Fig. 2.

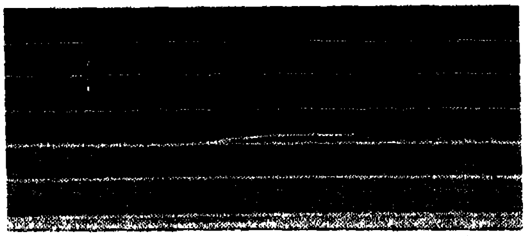


Fig. 2.

Prior to recording, the optical system is aligned and adjusted by trial and error. The distance between the light source and the manometer, as well as the distance between the manometer and the paper, must be regulated to achieve sharp contrast. The unit is filled with physiological saline solution. Hydrostatic pressure from the liquid in the inflow and outflow arms forces bromobenzene into the manometer, the meniscus of which establishes a base or zero pressure line. A catheter from the ureter filled with either physiological saline solution or urine is connected to the apparatus; any bubbles which appear during this maneuver can be evacuated by means of the valve on the inflow conduit.

A more complete study of the ureter is possible when an automatic drop recorder is appended to the unit.

It has been found that intravenous infusion of a 5- or 10-per cent dextrose solution during the course of an experiment insures a motile ureter, whereas hypodermic administration does not always promote a diuresis adequate to stimulate the ureter.

References

1. Hodgman, Charles D. (Ed.). *Handbook of chemistry and physics.* (23rd ed.) Cleveland: Chemical Rubber Publishing Co., 1939.
2. Kirchhof, Anton C., and David, Norman A. *West J. Surg. Obstet. Gynec.*, 1943, **51**, 277–279.
3. Trattner, Harry Robert. *J. Urol.*, 1924, **11**, 477–487.

The Estimation of Streptomycin in Body Fluids

Clifford W. Price, Jean K. Nielsen, and Henry Welch

Food and Drug Administration, Washington, D. C.

Increasing interest in streptomycin as a chemotherapeutic agent has made apparent the need for a simple method for estimating the concentration of this drug in body fluids.

Stebbins and Robinson (*3*) proposed an agar cup-plate method of assay employing *Staphylococcus aureus* SM as the test organism. This method, which measures concentrations of from 1 to 20 micrograms/ml., requires materials and techniques which may not be readily available in a small laboratory.

A 3-hour turbidimetric assay, which had been giving accurate and reproducible results when aqueous or buffered solutions of streptomycin salts were assayed, was investigated. This method, which employs a non-encapsulated strain of *Klebsiella pneumonia*, was found to be unsatisfactory because of the stimulating effect exerted by body fluids on the test organism.

A survey of our stock cultures demonstrated that several were sensitive to streptomycin when examined by the serial dilution method, employing a modified medium consisting of peptone 1 per cent, beef extract 0.5 per cent, and sodium chloride 0.25 per cent adjusted to pH 7.8–8.0 with NaOH. Further investigations revealed that one of these, *Bacillus circulans*, was the most sensitive and gave accurate, reproducible results with various body fluids. Consequently, it was chosen as the test organism.

B. circulans is a mesophilic, motile, aerobic spore-bearing microorganism. It grows well at temperatures between 30° and 37° C., forming floccules which make the end point in the serial dilution test relatively easy to determine. It is sensitive to 0.15 microgram/ml. of streptomycin base. Broth cultures are quite stable and may be preserved in screw-cap bottles under refrigeration for periods of one month with no appreciable loss in sensitivity.

Technique of the test: Amounts (0.5 ml.) of the modified nutrient broth are placed in sterile Wasserman tubes and serial dilutions by halves made by adding 0.5 ml. of the fluid being tested to one of the tubes and carrying 0.5 ml. by serial dilution for the desired number of tubes. The first tube in the series contains 0.5 ml. of the solution under test only. A standard is prepared for comparison by diluting a streptomycin salt of known potency in broth to contain 10 micrograms of the base per milliliter. This standard is serially diluted in the same manner as the body fluid under test. One and one-half milliliter of a 1:100 dilution of the test organism in broth is then added to all tubes, after which they are incubated overnight. The last tube in which no growth occurs is considered the end point.

The concentration of streptomycin in the unknown is then determined by comparing the end point with that of the standard. An example is given in Table 1, in which it will be noted that the standard completely inhibited growth of *B. circulans* in the fifth tube.

TABLE 1

Fluid	Tube No's.						
	1	2	3	4	5	6	7
Standard	0	0	0	0	0	+	+
Serum	0	0	0	+	+	+	+
Urine 1:50	0	0	0	0	+	+	+

Since this represents 10 micrograms, the serum tested contains *one-fourth as much, or 2.5 micrograms*; the urine which caused complete inhibition in the fourth tube contained 5 micrograms × 50 or 250 micrograms/ml. To determine lower potencies it is necessary to vary the dilution series of standard and unknown.

In a similar method (*2*), employing *Bacillus subtilis* for determining penicillin in body fluids, it was found that unexplained inhibitory substances often interfered, necessitating a control series for proper evaluation (*1*). To determine whether similar inhibitory factors were present against *B. circulans*, the sera from approximately a hundred individuals were tested. Only one of this number possessed inhibitory properties in a serum dilution of 1:4 for *B. circulans.* In a second series, the sera of 40 individuals being treated with oral penicillin were also examined for inhibitory substances against this organism. Three of these showed inhibition in serum dilutions of 1:4. The greater majority of these persons had received penicillin many times in the past. The possibility that penicillin in some cases may actually induce formation of these inhibitory substances is worthy of consideration. In no instance was the penicillin concentration itself sufficiently high to act as an inhibitor of the test organism. Inasmuch as the effect of these inhibitory substances on the validity of results obtained by this serial dilution method for determining streptomycin is practically negligible, the use of a control series on each serum does not appear necessary.

References

1. Chandler, V. L., Price, C. W., and Randall, W. A. *Science*, 1945, **102**, 355–356.
2. Randall, W. A., Price, C. W., and Welch, H. *Science*, 1945, **101**, 365–366.
3. Stebbins, R. B., and Robinson, H. J. *Proc. Soc. exp. Biol. Med.*, 1945, **59**, 255.

Continuous Anesthesia for Insects

Carroll M. Williams

Society of Fellows, Harvard University

Although surgical procedures on insects have already furnished a substantial body of information with regard to developmental physiology and morphogenesis, such studies have in most cases been difficult to perform, due to the lack of an adequate method of maintaining insects anesthetized for prolonged periods of time. Many insects, especially in immature stages, have shown marked resistance to ether, the agent most commonly employed, and, furthermore, its effect is usually so transient that only the briefest procedures are generally possible before the anesthesia must be repeated.

It has long been known that insects are rapidly and reversibly anesthetized by carbon dioxide, but, here again, recovery occurs so quickly that little can be accomplished. What is needed is a method of administering continuously an anesthetic concentration of carbon dioxide.

During the past year such a method has been developed and tested. It has now been used routinely on a sufficiently large array of insect species to demonstrate its general utility, and it has also been used with uniform success at a number of other laboratories. The only requirements are a Buchner funnel of suitable size and a tank of carbon dioxide (Fig. 1). The operations are performed in the open depression of the funnel, through the bottom of which passes a slow stream of gas from the cylinder. Since carbon dioxide is heavier than air, it persists in the mouth of the funnel, making a lid unnecessary. Any depth of anesthesia can be established and maintained by merely adjusting the rate of gas flow.

For minute dissections it has been found most satisfactory to mount the funnel flush in the top of a table and just beneath a dissecting microscope. For microscopes with elevated stages, the funnel can be fitted to a metal plate and substituted for the glass stage, thus affording a portable unit. In order to indicate the rate of flow of the gas and to prevent evaporation from the insect, it is desirable to bubble the carbon dioxide through water before passing it into the funnel.

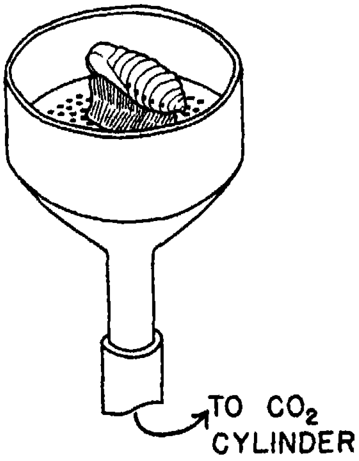


Fig. 1.

The animal to be studied is simply placed in the funnel, where it rapidly becomes anesthetized. The rate with which this occurs varies enormously among different types and stages of insects, being almost instantaneous for most adult and larval forms and considerably longer for pupae. In the latter case it may be necessary to cover the funnel briefly in order to induce anesthesia. For most insects a tension of carbon dioxide amounting to one-fourth of an atmosphere serves to maintain anesthesia, so that a slow flow of gas suffices. When used routinely, a large cylinder of carbon dioxide lasts for several months.

The rate of recovery following removal from the funnel also shows great variation among different insect species, but in my experience complete recovery always occurs, even though the anesthesia may have lasted for considerably more than an hour.

Insects anesthetized by this means show complete relaxation; the integument can be opened, the operation performed, and the body wall sealed shut again without the loss of a drop of blood. The method can be confidently recommended to students of insect physiology.

Letters to the Editor

Pleistocene Fossil Excavations at Blue Licks Spring, Kentucky

Fearful that the proposed U. S. Flood Control dam near Falmouth might permanently impound water to a considerable depth over the well-known Pleistocene vertebrate fossil site at Lower Blue Licks Spring on the Licking River in the northeastern bluegrass region of Kentucky, Major Victor K. Dodge, a distinguished amateur naturalist of Lexington, recently sponsored at his own expense an experimental excavation to prove that a wealth of unrecovered fossil bones of Glacial animals was still to be had for the digging at this famous locality. The writer was requested by Major Dodge and Mr. William J. Curtis, curator of the adjoining Blue Licks State Park Museum, to be present and to aid in the direction of the exploration.

About two wagonloads of ''big bones,'' principally *Mastodon americanus*, but with some representatives of *Elephas primigenius*, *Magalonyx jeffersonii*, *Symbos cavifrons*, and *Bison bison*, if not *latifrons* and/or *antiquus*, had already been taken from this site by Thomas W. Hunter (deceased) from hand-dug trenches surrounding the old saline-sulphur spring during the period 1897–1900. These ''big bones'' are now in the museum at Blue Licks State Park.

The Dodge exploration was begun with a bulldozer on the morning of 14 October 1945 along a selected strip 8 to 10 feet wide and about 20 feet removed to the southwest from the old salt spring. Three feet of brown silt-loam, sand, clay, gravel, and loose limestone slabs and rubble were removed. This bed of unconsolidated river deposits gave much evidence of having been previously turned over, probably by Mr. Hunter. Beneath it, an additional 1½ feet of alluvial deposit was found to contain scattered brownish fragmental bones of the deer, the elk, and the buffalo. This upper 4 to 4½ feet is of Recent and sub-Recent (post-Glacial) age.

Immediately below the river deposits described above, there appeared in the excavation a black, coarse, firmly-cemented gravel, the pebbles or cobbles of which, when broken, revealed usually chert, occasionally fine sandstone or dense crystalline limestone. These pebbles were set in a matrix of countless small Pottsville quartz pebbles and fine quartz sand, the entire bed ranging from 3½ to 4 feet in thickness. This bed was of a very dark or gray-black to jet-black color, due to thorough impregnation of sulphur and iron, the latter forming the cement of the bed. This semiconsolidated gravel is definitely of fluvial origin and of late Pleistocene age. It rests directly on water-cut and grooved, Cynthiana (upper Ordovician) limestone, bedded and in place. The entire fluvial section, opened down to the bedded limestone at Blue Licks Spring, ranges in thickness from 8 to 9 feet, depending upon the level encountered in the underlying limestone.

When the black gravel was encountered in the excavation, the writer recommended disuse of the bulldozer and began careful removal of the pebbles from the gravel by hand pick. Almost immediately a shoulder blade, vertebrae, and short limb-bones of the Bison were revealed on the southwest side of the cut and were carefully removed. Turning then to a lower exposure of gravel in the northeast side of the trench, discriminate digging soon exposed a very large limb bone which, when completely uncovered and removed, proved to be about half of the humerus of the Mastodon. Later, two fractional vertebrae and about 7 feet of the tusk of a Mastodon were uncovered. Of this tusk some 3 feet crumbled, the balance of nearly 4 feet being removed. During the slow hand-digging necessary to find and lift these frail Pleistocene vertebrate fossils, an inconspicuous fragment of bone was removed which, now that it is cleaned, appears to be about half of the lower mandible of *Castoroides ohioensis*, the giant Glacial beaver, and the first to be recognized at this locality.

All of the ''big bones'' recovered in this exploration were found to occur exclusively in the hard, basal, black gravel. Several of them, including the Mastodon tusk, give evidence of stream wear or planation; all were separately imbedded in disorder in the gravel when it was a soft and unconsolidated river-deposited bed surrounding the salt spring, prior to the accumulation of any of the overlying brown, silty, sandy loam.

The Pleistocene fossil bones recovered in this exploration were immediately removed by Major Dodge to the University of Kentucky Archaeological Laboratories in Lexington, where they have been cleaned and placed upon exhibition by Professor W. G. Haag.

After the removal of the Mastodon tusk late in the afternoon, the bulldozer was re-employed, the trench, then about 8 or 10 feet wide and exposing 15 or 20 feet of the black gravel bone-bed, was quickly refilled, and the surface leveled to approximately its original appearance before the end of the day. Approximately 75 people—many of them active amateur naturalists, others scientifically trained in archaeology, including Dr. Charles E. Snow, anthropologist of the University of Kentucky—were present from northern central Kentucky, southwestern Ohio, and southeastern Indiana.

This modern, quickly executed fossil hunt has confirmed the previously expressed opinion of Major Dodge, the writer, and others that the Lower Blue Licks Spring is still a locality rich in Pleistocene vertebrate fossils. The success of the undertaking points dramatically to the immediate importance of formulating some systematic, adequately financed plan which will make it possible to prospect thoroughly the two-acre, old bog between the former salt spring and the Licking River channel, and to recover for the use of science the undoubtedly large amount of vertebrate paleontological material still entombed there. Possibly as the result of such promptly and properly executed excavations many bones, if not complete skeletons, of those missing members of the American Pleistocene fauna, *Equus complicatus*, *Tapirus haysii*, *Mylodon harlani*, *Ursus americanus*, and some representatives of the exceedingly rare *Canidae* and *Felidae*, neither of which are now known in Kentucky, may be recovered, with consequent enrichment of our knowledge of the mammalian scene immediately south of the continental ice sheet during the last stages of the Glacial age.

Willard Rouse Jillson

Frankfort, Kentucky

Why Not?

Settlement of the atomic bomb question is the most urgent of all Government problems. While our statesmen play Pearl Harbor politics in the house of state the conflagration of a Third World War is already smoldering in the basement. The public is fast asleep or unaware of its implications. I suggest that the AAAS take the lead in getting all state academies and science clubs to present the facts in terms of destruction by the atomic bomb to the public, labor organizations, American Legion, etc., furnishing them with a plan of action.

Lyell J. Thomas

University of Illinois

An Appeal

We the undersigned, wives of American scientists, have read with interest and concern the "News from Abroad" in recent issues of *Science*. We want to help these scientists, victims of the Axis, and we suggest the desirability of supplementing the work of the established relief agencies by sending gift packages of clothing and food directly to individual scientists and their families. Some of us have already sent packages to friends whose present addresses are known, and the acknowledgments we have received leave no doubt of the urgent need which these packages are helping to meet. Used clothing and shoes are genuinely appreciated.

American scientists who would like to send packages to colleagues of the occupied countries may obtain names and present addresses from the Secretary of this group. It is suggested that you indicate the country of your greatest interest and the ages of the children for whom you can supply clothing. We have just received from the Netherlands the names of some forty families with suggestions as to what clothing, etc., would best help them. Warm clothing and shoes seem to constitute their greatest need.

A package sent *now* is worth six sent next spring.

Langhorne H. Brickwedde, Louise McD. Browne, Emilie H. Condon, Lola S. Deming, Edith O. Hendricks, Mildred R. Masi, Grace H. Ruark, Grace H. Smith, *Secretary*.

National Bureau of Standards

Ch'ang Shan, a Chinese Antimalarial Herb

Ch'ang Shan, the roots of *Dichroa febrifuga* Lour., has long been used in China for malaria, but as far as we are aware, no scientific studies had ever been made on its antimalarial action until 1942, when a solid extract of this herb was tried on 13 clinical cases of tertian malaria. A dose of 0.03–0.06 gram of the extract (equivalent to about 7.5–15.0 grams of the crude drug) was administered by mouth twice or three times daily for an average of 5 days. In comparison with the results of 152 quinine-treated cases, Ch'ang Shan appeared to be as prompt as quinine in controlling the fever, but its antiparasitic effect was a bit slower, requiring one more day than quinine in converting positive smears into negative.

Both the antipyretic and antiparasitic effects of Ch'ang Shan were demonstrable in experimental animals. A simple decoction of the crude drug was able to reduce the febrile temperature of rabbits inoculated with *B. coli* vaccine. Chicks infected with *Plasmodium gallinaceum* run a course of malaria which is almost invariably fatal if not treated. Ch'ang Shan (1 gram/kgm.), given by stomach tube twice a day for 1 to 7 days, controlled the infection in all cases, as shown by the conversion of positive smears into negative and the prolongation of the survival periods. Such treatment did not, however, prevent relapses, which usually occurred sooner or later. In doses of only about one-fifth that of Ch'ang Shan, the leaves of the same herb (Shuu Chi) were found equally effective.

In the Chinese Book of Herbs (*Pen Ts'ao Kang Mu*), Ch'ang Shan belongs to the category of poisonous herbs. Nausea and vomiting were, however, the only toxic reactions observed in our clinical cases. Acute toxicity tests were made on 5 dogs, 37 ducklings, and 56 chicks, L.D. 50 being 20 grams/kgm. (approximate), 22 grams/kgm., and 14 grams/kgm., respectively. Fatal doses of Ch'ang Shan produced in dogs intense congestion with numerous hemorrhagic patches throughout the whole gastrointestinal tract. Aside from some congestion, no specific lesions were found histologically in the liver, spleen, and kidneys.

With a view to isolating the active principle or principles, our chemical studies were checked at every step by testing on chicken malaria. Up to the present time we have succeeded in isolating from both Ch'ang Shan and Shuu Chi four crystalline substances. Two of these are neutral principles: Dichrin A (m.p. 228–230° C.) and Dichrin B (m.p. 179–181° C.); the other two are alkaloids: Dichroine A (melting at 230° C. with decomposition) and Dichroine B (melting at 237–238° C. with decomposition). In the doses tried, only Dichroine B was found to be effective for chicken malaria, while the other three were all inactive.

C. S. Jang, F. Y. Fu, C. Y. Wang, K. C. Huang, G. Lu, and T. C. Chou

Pharmaceutical Laboratory,
National Institute of Health,
Chungking, China

Book Reviews

How a baby grows: a story in pictures. Arnold Gesell. (With over 800 photographs, arranged and interpreted with the assistance of Katherine Gesell Walden.) New York: Harper, 1945. Pp. 77.

Few scientific careers have been marked by such continuity and concentration of effort as that of Dr. Arnold Gesell. His interest in the young child dates back at least to 1905, when, as a young graduate student, he reported in Professor Burnham's seminar at Clark University on Pestalozzi and Preschool Education. When, a half dozen years later, he completed the manuscript of his first book, *The normal child and primary education,* he was already committed to a lifetime of research on the young child. In order to prepare himself more adequately for his chosen work, he entered upon and completed a medical course at Yale University. Since that time he has authored about twenty volumes, several monographs, and scores of articles on infant and child behavior. Techniques developed in his laboratory at Yale include cinema analysis of behavior patterns and pattern phases, biometric and clinical procedures for the study of maturational differences, the method of co-twin control, and the now-popular screen for one-way visual observation. Among his most important publications are *Mental growth of the pre-school child: an atlas of infant behavior* (two volumes, 3200 action photographs); *The first five years of life: a guide to the study of the pre-school child*; *Twins T and C from infancy to adolescence* (with Thompson); *Developmental diagnosis: clinical methods and practical applications* (with Amatruda); *Infant and child in the culture of today* (with Ilg); and *The embryology of behavior.*

The book here reviewed is a picture story intended to illustrate "the hidden forces of growth which shape the baby's behavior day by day, month by month." There are in all about 800 photographs, selected and arranged to illustrate average trends with respect to (1) control of body and conquest of the physical world, and (2) the development of personality, emotional life, and social adjustments. Topics covered bear the following titles: Infant eyes, Infant hands, Infant feet, Creeping, Babies are not alike, Natural exercise, Sleep, The sense of touch, Play, The bath, Sitting, The baby stands, Infant and family, The patterning of personality, A mirror playmate, Crying, Smiling, Language behavior, A baby's day at twelve weeks, A baby's day at thirty-six weeks, Behavior patterns at one year, Learning and growth, The first three months, The second three months, The third three months, The fourth three months, Early drawing, Block building, The pre-school years, The school beginner, Inborn individuality, Infants are individuals.

Each topic is prefaced by a brief introduction and followed by anywhere from twelve to forty descriptively labeled photographs. The ontogenetic story told in these pictures and the accompanying text is simple enough to be grasped by any intelligent layman, yet interesting to the scientist because the photographs are representative of average growth and behavior. It is, therefore, both a primer and an authentic outline of child development. The author emphasizes, however, that no one baby can be expected to follow the average pattern and that all children are individuals with distinct personalities.

The task of preparing such a booklet was far less simple than might at first appear, for it involved the selection from thousands of photographs just the few hundred that would give the most accurate bird's-eye view of typical behavior development. It is a story that no one else could have told so authoritatively; Gesell alone has such a wealth of photographic materials from which to draw and so rich a background of psychological and pediatric experience for their interpretation.

Here, as in all of Gesell's writings, we see not only the meticulous investigator but one who is also keenly aware of the dramatic aspects of his data—a scientist who has something of the poet in his make-up.

LEWIS M. TERMAN

Stanford University

The Maya of East Central Quintana Roo. Alfonso Villa R. Washington, D. C.: Carnegie Institution of Washington, 1945. Pp. xii + 182. (Publication 559; illustrated.) $2.25.

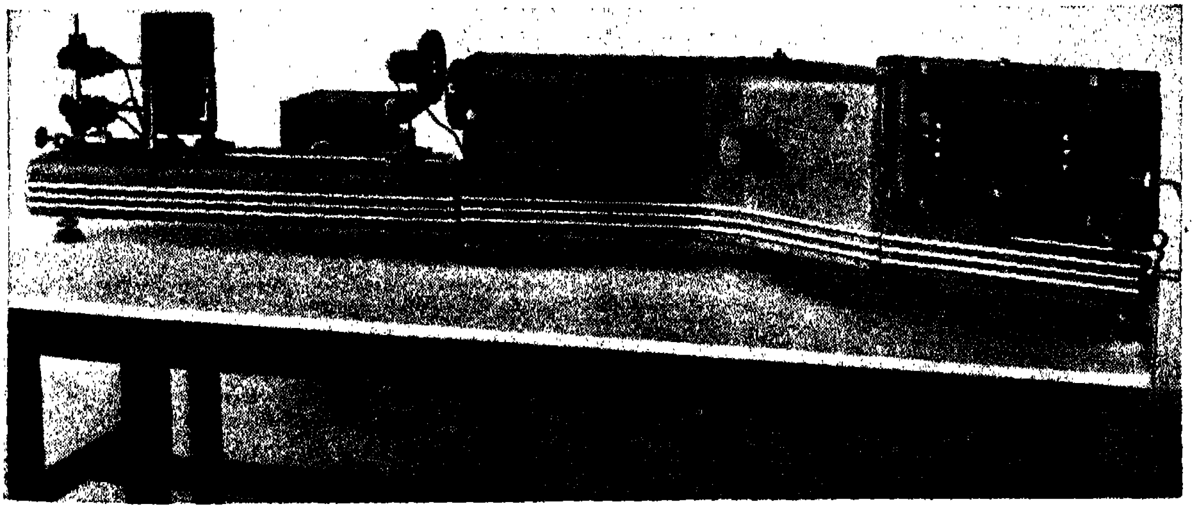
The Mexican ethnologist, Alfonso Villa R., has in this volume produced a careful monographic study of the so-called X-Cacal tribe of partially acculturated Maya Indians of the chicle forest region of Quintana Roo, of the southeastern part of the peninsula of Yucatán. The community to which most attention was given is Tusik, and the group as a whole is culturally the most isolated of the area. The study was undertaken as part of a general plan of investigation involving four communities ranged on a "gradient" of acculturation or transition from relatively primitive (folk) culture through various stages of change to the culture of the modern city of Mérida, Yucatán. The study as a whole was carried out under the auspices of the Carnegie Institution of Washington and was directed by Dr. Robert Redfield, who has summarized the data and theoretical principles in his book, *The folk culture of Yucatan* (1941). The present monograph deals with the most "primitive" or "least civilized" of the four groups involved.

The author has proceeded with great meticulousness not only to set down the present-day culture of the people but to reconstruct, so far as possible, the aboriginal culture of their Maya ancestors of the region and the historical vicissitudes to which the culture and the area have been subjected. As a straight ethnographic account, therefore, the book rates as a model monograph.

No one should suppose, however, that the "primitive-

BAUSCH & LOMB

MEDIUM QUARTZ SPECTROGRAPH



This instrument covers a wavelength range of 2100 A. to 7000 A. dispersed over a length of ten inches. Because of the sharpness and cleanness of the lines provided by this spectrograph, analyses are often feasible which would ordinarily require a larger instrument. Accurate quantitative analyses of non-ferrous metals and alloys are possible. Rough estimates can be made of amounts of elements yielding spectra of moderate complexity. For complete description write for Catalog D-20. Bausch & Lomb Optical Co., Rochester 2, N. Y.

BAUSCH & LOMB

ESTABLISHED 1853

A reissue of a
Princeton classic . . .

The Meaning of Relativity

by

ALBERT Einstein

"The first edition of this book, published in 1922, consisted of the text of the Stafford Little lectures, delivered by Dr. Einstein in May, 1921, at Princeton University. This has ever since been regarded as the authoritative statement of his theory of relativity. For this second edition, Dr. Einstein has added an appendix translated by Ernst G. Straus, in which he discusses certain advances in the theory since that earlier presentation of it."—*Scientific Book Club Review.*

"The treatment follows what may be called normal lines, and, coming from the 'Father of Relativity', is naturally authoritative and interesting in approach. It is, moreover, concise and to the point."—*Science.*

142 pages, indexed, 5¼" x 7½", $2.00

At your bookstore

PRINCETON
UNIVERSITY PRESS

ness" of these communities and their culture means "aboriginal," for it is very apparent from the material presented that the X-Cacal have a culture which represents, so far as its content is concerned, a considerable mixture of aboriginal and Spanish elements—a mixing and mingling of artifacts, action customs, and idea patterns which extends through almost every department of custom from subsistence systems to ceremonialism. And in the process of assimilating historically diverse traits to this mixed culture a certain reintegration and synthesis has apparently been at work, with the result that something new has been produced. In this process Maya influence has probably been greatest. An ancient Maya might find slightly more in common with a present-day X-Cacal member than would a Spaniard of the Fifteenth Century, but both the *old* Maya and the old Spaniard would discover in the modern culture of East Central Quintana Roo "a world they never knew."

Thus it is that the X-Cacal group does represent a folk culture of the present day which may be usefully contrasted with the modern urban way of life in Mérida and other Latin-American metropolises, but it is "primitive" primarily in the sense that the culture is still relatively homogeneous, still bound together by a universally accepted system of beliefs, still comparatively unspecialized and undiversified, rather than in the sense that it might be considered a survival into our time of ancient Maya culture.

Señor Villa does not attempt an overall summary along these lines nor does he give much explicit attention to processes of cultural blending and emergence as such, perhaps wisely contenting himself with setting down his data in a form which will be extremely useful for other students. Some readers may wish that he had provided at least one chapter of interpretation in terms of theoretical principles, for it is always helpful and stimulating for others to have the theoretical views and tentative conclusions of the man who collected the data. However, we have no reason to complain, for Señor Villa has provided us with a carefully collected and painstakingly documented body of data which should prove valuable not only for our understanding of the cultures of the Yucatecan peninsula, but also for analysis of all mixed or "Creole" cultures which, in one form or another, are characteristic of much of modern Latin America.

JOHN GILLIN

Duke University

NSF—*Continued from page 45*

Department of Mathematics, New York University; I. M. Kolthoff, professor of chemistry, University of Minnesota; Getrtrude Kornfeld, research chemist, Eastman Kodak Company, Rochester, New York; Lawrence S. Kubie, psychiatrist, 7 East 81st Street, New York City.

Lane W. Lancaster, Department of Social Science, University of Nebraska; Walter B. Lancaster, ophthalmologist, 520 Commonwealth Avenue, Boston, Massachusetts; Alfred C. Lane, emeritus professor of geology, Tufts College; Harry Langman, Mathematician, 1196 Eastern Parkway, Brooklyn, New York; Ralph Linton, professor of anthropology, Columbia University; M. Stanley Livingston, professor of physics, Massachusetts

Institute of Technology; Leo Loeb, emeritus professor of pathology, Washington University Medical School; J. Murray Luck, professor of chemistry, Stanford University.

D. MacDougal, botanist, Route 170, Carmel, California; W. Rupert MacLaurin, professor of economics, Massachusetts Institute of Technology; William M. Malisoff, professor of chemistry, Brooklyn Polytechnic Institute; Evelyn B. Man, Department of Chemistry, Yale University; Henry Margenau, professor of physics, Yale University; Donald G. Marquis, professor of psychology, University of Michigan; Dorothy P. Marquis, Yale University Medical School; W. T. Martin, professor of mathematics, Syracuse University; Mark A. May, Director, Institute of Human Relations, Yale University; Barbara McClintock, geneticist, Carnegie Institution, Cold Spring Harbor, New York; J. H. Means, professor of clinical medicine, Harvard Medical School; Joseph L. Melnick, Yale University Medical School; H. Meltzer, Director, Psychological Service Center, St. Louis; Fred A. Mettler, professor of neurology, Columbia University Medical School; Otto Meyerhof, professor of chemistry, University of Pennsylvania Medical School; Howard A. Meyerhoff, Executive Secretary, AAAS, Smithsonian Institution Building, Washington, D. C.; Walter R. Miles, professor of psychology, Yale University; P. H. Miller, Jr., professor of physics, University of Pennsylvania; George R. Minot, Harvard Medical School; S. A. Mitchell, Director, McCormick Observatory, University of Virginia; Wesley C. Mitchell, economist, 2 Howard Street, New York City; Stuart Mudd, University of Pennsylvania Medical School; Gardner Murphy, professor of psychology, College of the City of New York.

Louis Nahum, Yale University Medical School; Edwin G. Nourse, Brookings Institution; Alex B. Novikoff, Brooklyn College, New York.

Mervin E. Oakes, Queens College, New York City; William F. Ogburn, professor of sociology, University of Chicago; Jean Oliver, professor of pathology, Long Island College of Medicine, New York City; J. Robert Oppenheimer, professor of physics, University of California; Bernard L. Oser, President, Food Research Laboratory, 4814 33rd Street, Long Island City, New York.

D. H. Palmer, 271 West 70th Street, New York City; Alvin M. Pappenheimer, Columbia University Medical School, 630 West 168th Street, New York City; Leland W. Parr, professor of bacteriology, Washington University Medical School; Talcott Parsons, Emerson Hall, Harvard University; W. W. Pierson, Dean, Graduate School, University of North Carolina; William E. Powers, College of Liberal Arts, Northwestern University; John P. Peters, Yale University Medical School; R. A. Phillips, Rockefeller Institute for Medical Research, New York City; A. P. Poffenberger, professor of psychology, Columbia University.

Hans Rademacher, professor of mathematics, Swarthmore College; Walter Rautenstrauch, professor of engineering, Columbia University; H. H. Remmers, professor of psychology, Purdue University; Robert Redfield, professor of sociology, University of Chicago; Oscar K. Rice, professor of chemistry, University of North Carolina; Charles E. Rickart, Department of Mathematics, Yale University; Bernard F. Riess, Hunter College, New York; David D. Rutstein, Deputy Commissioner of Health, New York City.

Alexander Sandow, professor of biology, New York University; George Saslow, Washington University Medical School; Arthur L. Schade, Overly Biochemical Research Foundation, 254 West 31st Street, New York City; Karl P. Schmidt, Chicago Natural History Museum; Isaac Schour, University of Illinois Dental School; Henry Schumacker, Cleveland Guidance Center; Robert R. Sears, Director, Child Welfare Research Station, State University of Iowa; Carroll L. Shartle, professor of psychology, Ohio State University; Theodore Shedlovsky, Rockefeller Institute, New York City; Sumner H. Slichter, professor of history, Harvard University; Gustaf Soderberg, 412 Turner, Chevy Chase, Maryland; Joseph John Spengler, Department of Economics, Duke University, Durham, North Carolina; Warren M. Sperry, Columbia University Medical School; Lyman Spitzer, professor of astronomy, Yale University; L. J. Stadler, professor of genetics, University of Missouri; John M. Stalnaker, Dean, Stanford University; Vilhjalmur Stefansson, explorer, 67 Morton Street, New York City; H. Burr Steinbach, professor of zoology, Washington University; William E. Stephens, professor of physics, University of Pennsylvania; George W. Stocking, professor of economics, University of Texas; Gustaf Stromberg, Mount Wilson Observatory.

C. Fayette Taylor, professor of engineering, Massachusetts Institute of Technology; Leland H. Taylor, professor of biology, West Virginia University; Lloyd W. Taylor, professor of physics, Oberlin College; Dorothy Swaine Thomas, University of California, Berkeley, California; Warren S. Thompson, Scripps Foundation, Miami University, Oxford, Ohio; Ralph W. Tyler, Dean of Education, University of Chicago.

Wilbur G. Valentine, Department of Geology, Brooklyn College; Maurice B. Visscher, professor of physiology, University of Minnesota.

Selman A. Waksman, Agricultural Experiment Station, New Brunswick, New Jersey; David Webster, Department of Physics, Stanford University; Nathaniel Weiner, Endo Products, Inc., 84–40 101st Street, Richmond Hill 18, New York; E. W. Went, professor of botany, California Institute of Technology; F. W. Weymouth, professor of physiology, Stanford University; Abraham White, Yale University Medical School; Philip R. White, Rockefeller Institute, Princeton, New Jersey; J. Stewart Williams, professor of geology, Utah State College; William F. Windle, Director, Neurological Institute, Northwestern Medical School; Louis Wirth, professor of sociology, University of Chicago.

Robert M. Yerkes, emeritus professor of psychobiology, Yale University; Donald Young, Chairman, Social Science Research Council, 230 Park Avenue, New York City; Ralph A. Young, professor of economics, University of Pennsylvania.

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Laboratory combustion furnace. A folder from the Laboratory Equipment Corporation describes their new postwar high temperature combustion furnace. The unit is particularly suited for laboratory use because its overall dimensions are but 23 inches high, 23 inches wide, and 18 inches deep, with a gross shipping weight of 350 pounds. The specifications submitted indicate that the operating temperatures for sulphur analysis are 2600 to 2700 degrees F. and 2300 to 2600 degrees F. for carbon analysis of alloy steels. Other details include extra-heavy insulation, heavy cast aluminum housing and three-quarter inch Silicon Carbide rod elements. *Leco 2600 high temperature combustion furnace, data sheets, SC–461.* Laboratory Equipment Corp., Benton Harbor, Michigan.

COLLEGE TEXTS

Hegner's

COLLEGE ZOOLOGY

Well known as the outstanding text in its field this general survey for students who will not take advanced work is here happily combined with detailed instruction sufficient for those who will. In the organization of material, the author's purpose has been to train students in the methods of scientific investigation. 5th Ed. $3.75

BRUNER'S LABORATORY DIRECTIONS IN COLLEGE ZOOLOGY corresponds with Hegner's *College Zoology* but is sufficiently detailed and comprehensive for use with standard texts other than Hegner's. 3rd Ed. $1.75

Walter's

BIOLOGY OF THE VERTEBRATES

This text has long been a favorite with students and teachers alike for its exceptionally readable, interesting style; its completeness and clear organization of content; and its wealth of well-drawn, helpful illustrations. It presents all the materials which are useful in college courses on the vertebrates or on comparative anatomy. 2nd Ed. $4.00

Essig's

COLLEGE ENTOMOLOGY

This foundation text in entomology covers the history of the 33 orders of insects, emphasizing those species which, because of their historical background, economic importance, or unusual and interesting appearance, should be known to all students of natural history. Full lists of families, keys for separating the various categories of insects, and abundant illustrations, largely original, are included. $5.00

Huettner's

FUNDAMENTALS OF COMPARATIVE EMBRYOLOGY OF THE VERTEBRATES

A modern approach and interpretation, thorough scientific accuracy, and original copperplate illustrations, all exceptionally clear, detailed, and accurate, make this an unusually fine text for students of embryology. $4.50

THE MACMILLAN COMPANY

60 FIFTH AVENUE NEW YORK 11, N. Y.

19 MAR 1946

SCIENCE

Vol. 103, No. 2664

Friday, January 18, 1946

Science for Democracy

Ward Shepard

Soil Conservationist, U. S. Department of Interior, Washington, D. C.[1]

SCIENTISTS—whether they like it or not—are forced by the circumstances of this new age to reassess their role in civilization. They are the trustees of the magnificent instrument of scientific method and of the great public domain of organized knowledge. Our complex and disordered civilization can no longer function without incorporating scientific method into the whole body politic and cultivating the domain of organized knowledge for its greatest social yield. Science must become the right hand of statesmanship.

Science of and for democracy must lift its imagination above the test tube and the laboratory to the whole realm of human life. It must envisage its task, not in cold abstract terms of "pure" science, but in terms of humanity itself. The job of science is to put its shoulder to the wheel and help rid civilization of poverty, squalor, disease, ignorance, subjugation, and violence. Its job, in short, is to help build a science of civilization.

Science cannot do this job unless, first of all, it has generous and assured public financial support, especially for basic research, which, though often far removed from immediate "practicality," is nevertheless the foundation and touchstone of all scientific progress. Science cannot do this job unless its freedom of inquiry is rigorously safeguarded. And, above all, science cannot do this job if it remains on the periphery of our civilization instead of being at the center. Neither science nor government can flourish as long as science is penuriously treated as a scarcity product rather than as a basic necessity of democratic civilization.

These are the underlying concepts motivating the proponents of a far-reaching, government-sponsored, all-science program, in which organized society, through government, would join hands with organized science in making the most of science for human life.

Yet the ideal of a broadly conceived national science program is threatened by a division of opinion among scientists. The newly formed Committee for a National Science Foundation, sponsored by Drs. Harlow Shapley and Harold C. Urey, warns that this division threatens the possibility of Congressional legislation and calls on scientists for a united front. Their appeal is based, not on the self-interest of science and scientists, but on the urgent needs of civilization itself for democratic well-being, security, and world order.

This emergency has arisen because a minority group of scientists, spearheaded by the Committee to Support the Bush Plan, is still actively pushing the fragmentary and ill-organized program embodied in *Science, the endless frontier,* despite the fact that the exhaustive Senate hearings sharply challenged its pretensions of being a comprehensive, democratic, all-science program. The broad trend of the hearings was for a far more effective alliance between government and science than the Bush program would permit. And this trend represented a real cross-section of competent American opinion—of natural and social scientists, of private and government scientists, of educators, of leaders of labor, agriculture, and industry, and of leading government officials. These hearings produced great clarification of thought on the difficult problem of organizing science as the "brain trust" of civilization, so that it is now possible, by continuing the democratic process initiated by these hearings, to create legislation that will meet the united needs of science, of government, and of the people.

Science, the endless frontier, as an obstacle to the attainment of this end, deserves a more critical scrutiny than it has yet received. Philip Murray, in his statement to the Senate Committee, made an incisive appraisal of its general spirit. Referring to the testimony of its sponsors and of certain sponsors of atomic legislation, he said:

> None of this testimony expresses faith in the democratic process. . . . None of it spells out partnership between scientists and the people of America. It is full of private fears, and an expression of tender anxiety about the profit system and its incentives, and the easily hurt feelings of professional scientists.

Science, the endless frontier, signally fails to rise to its great opportunity. It lacks any wide and bold vision of the role of science in modern civilization. It abdicates the social responsibility of science. So far from bringing science "to the center of the stage," as it proclaims, it would isolate it from the main current of human affairs. Despite its declaration of the "unity of science," it would dismember science by casting the social sciences into the outer darkness. Its "tender anxiety about the profit system" is indicated by its evasion of the immensely important patent issue and its complete faith in modern industrialism as the chief mode of applying science to human welfare.

---

[1] The views expressed in this article are personal and unofficial.

The basic trouble with the Bush program is that, beneath the surface, its preoccupation is political rather than scientific. It sets up an intricate defense in depth against the well-worn bogeyman of "government intervention." There is no doubt that the creators of the Bush program profoundly believe that the least government is the best government.

Pertinent to this ideological stand is the fact that the Bush Committees had a considerable representation of large corporations, including Standard Oil and Du Pont, and of large private foundations. Most of its scientific membership was drawn from the Northeast, especially from the endowed universities. The smaller institutions and the underdeveloped regions were scantily represented. Equally striking was the fact that there were only two representatives of the immense array of government research agencies, and none whatever of the growing body of expert public administrators devoted to making democratic government socially efficient. There were no representatives of organized labor or of agriculture, both of which have an immense stake in the social application of technology. The insulation of the committees against social ideas is further indicated by the fact that there was no psychiatrist on the medical committee.

In essence, this natural science program is a system of government grants-in-aid to be administered by a virtually autonomous board of dollar-a-year men. The board's great disbursing powers are to be matched by equally great appointive powers: it would have unrestricted powers to appoint all its principal administrative and advisory officials, as well as all the state, regional, and national advisory boards required to assist it. A second dismemberment of science is proposed: the large number of government research activities are left entirely outside the scope of the Foundation. A separate Science Advisory Board, also composed of dollar-a-year scientists, is to be created to coordinate the activities of these agencies. Contrariwise, almost nothing is said about the outstanding need of coordination in nongovernmental science.

In its zeal to prevent government "regimentation," the Bush group has produced a plan that would prove unsatisfactory to the Government and to scientists. The dollar-a-year device has not won the confidence either of Congress or of the public. If the Government is going to give substantial support to research, it will want to safeguard the public interest by putting administration in the hands of accountable public servants, with undivided loyalty. Moreover, the Government will want to say something about the over-all social efficiency of a national science program based on public funds. On the other hand, the scientists who have been allured by the doctrinal theory of "freedom" set forth in the Bush program should note well that what actually emerges is a powerful scientific oligarchy, with a combination of appointive and disbursing powers that could, in practice, control science and scientists without any effective check either from government or the great body of scientific workers.

The undemocratic ideology of the Bush program is high-lighted by the arbitrary exclusion of the social sciences. *Science, the endless frontier* makes it appear that President Roosevelt's letter requesting the formulation of a national science program excluded the social sciences. That interpretation is highly dubious. But even if it were not, a representative committee with a real vision of the social responsibility of science would have warned the President that science could not be meaningfully organized by sinking without a trace all the sciences, from psychology and economics to law and administration, that pertain directly to organized human society.

In the recent letter addressed by the Committee Supporting the Bush Plan, of which Dr. Isaiah Bowman is chairman, to President Truman, an entirely different excuse for the exclusion is given:

> The Bush report was based upon factual studies showing the need and outlining a program for Federal support in the basic sciences. There are no comparable data and program for the social sciences.

Unwary readers not acquainted with the Bush report—including even scientists and other people with disciplined minds—have no way of knowing that this statement is a piece of artful legerdemain. The joker is that the Bush program from its inception deliberately excluded the social sciences. Thus, what sounds like innocent wonderment at the absence of a social science program merely conceals the fact that it was planned that way.

According to the naive social theories implicit in *Science, the endless frontier,* the natural sciences are supposedly innocuous and neutral, whereas the social sciences are "dangerous" because they explore social traditions and institutions. Both of these implications are false. The atom bomb once and for all explodes the "neutrality" of technology. And to shelve the social sciences is sheer obscurantism. The modern world is inexorably confronted with change—swift, disruptive, and menacing. The ultimate question concerning the use of the social sciences is this: Shall we apply organized intelligence, in so far as possible, to understanding and directing change, or shall we leave change to the struggle of passion and factionalism?

The relatively youthful social sciences are, it is true, immature compared with the natural sciences. But their realism and usefulness have greatly increased in recent years as government has come to grips with depression, war, and reconstruction. If we are to have a national science program, we need a balanced all-science program, with the primacy lodged where it belongs, in the social sciences. If science is to make real sense in relation to human life, the natural and the social sciences must reinforce each other in a genuine partnership, for the natural sciences can function fully only as society is effectively organized. And both would be the gainers, in this partnership, for the natural sciences need to be humanized, the social sciences to improve their technical rigor.

The full use of all science, including social science, is indispensable for intelligent progress in all the great tangle of human problems that so compellingly confront modern government—for example, to cite only a few of them, full production and employment, social security, labor relations, race relations, public administration, public employment and relief, industrial monopolies, universal medical facilities, agricultural policy, the conservation of natural resources, regional development, the cause and cure of war, and the international allocation of raw materials and credit. At the best, without the full use of science, the vital decisions of government will have to be based largely on the inspired hunches of statesmen and administrators; and at the worst, on the quackery and factionalism of demagogues, supported by pressure groups.

In any national science program worthy of the name, the social sciences must be planted at the core of scientific effort, and especially at the core of government, which is their laboratory and testing ground. They must be planted there at the start, not at some hypothetical future time, as the Committee to Support the Bush Plan proposes. For, once the social sciences were put away in moth balls, they would be condemned to languish indefinitely in favor of an unlimited, planless, and socially irresponsible development of technology.

The recent statement by the Committee for a National Science Foundation, signed by more than two hundred scientists, mostly in the natural science field, disposes of the two main fears of the Bush program—the fear of government and the fear of social inquiry:

> The freedom of inquiry upon which science is dependent can be guaranteed for research under government no less than under private auspices.
>
> The government should support research in all fields of fundamental scientific inquiry relevant to national interest without arbitrary exclusion of any area.

Science can be democratically organized for far greater effectiveness and far greater real freedom than it can possibly achieve under an isolationist, laissez-faire regime. Nobody who believes in democracy wants government regimentation of science. But freedom itself must be consciously "organized," as the world is learning at the cost of two world wars and world depression.

There is a wide gap between disorganization and *regimentation which it is the function of a dynamic* democracy to fill with new forms of democratic, pluralistic, and efficient organization. The dramatic research that produced the atom bomb shows that skillful group-work can speed up scientific production enormously. Imagine, for example, a similar skill and energy—minus the war tension and the regimentation—applied to cancer, race prejudice, full production, or world peace. Science can be organized for full social efficiency without regimentation by providing scientists themselves with the cooperative tools of effective social workmanship.

Government can "intervene" to bring coherent purpose and united energy to bear on human affairs without assuming the role of managerial bureaucracy. It can do so by defining and delegating responsibility to given functional groups. Government can assist scientists in organizing science for full social efficiency without regimenting it. It can do so by putting the *main (though not the exclusive) responsibility* on the scientists themselves by giving them effective tools for cooperative action. To protect their freedom, the scientists themselves must be democratically represented in the National Science Foundation; and they must, moreover, work out democratic group methods for effectively organizing a much greater and more coherent scientific effort than anything hitherto visualized.

The National Science Foundation visualized by the Shapley-Urey Committee will require the active, democratic cooperation of state, regional, and national scientific bodies in formulating scientific programs and allocating scientific funds. Scientists themselves—and not government alone—must face the need of science, not merely for adequate financial resources, but for priorities and complete and adequate coverage of the whole scientific field, for cooperative research, for coordination of effort, and for wholehearted democratic application of the results of research. Democratic process demands that all scientists have a responsible voice and part in this movement.

Public welfare demands also that government have a voice and part in this movement. We need a body of responsible public servants with adequate means, *both financial and cooperative*, to assist the organized scientists in making the most of our national scientific effort. Its role of promoting coordination would apply both to governmental and nongovernmental research agencies, but it would be facilitative rather than managerial.

In such a formula, we have a two-way, cooperative-bargaining arrangement between government and science. It would avoid the evil of the Government trying to dominate science and the equal evil of frittering away our scientific talent through fragmentation and financial inanition. It would preserve scientific freedom, but it would bring a vastly increased energy, order, and responsibility into our total scientific effort. If democracy is to function, it must be efficient; and it can be efficient without regimentation. Disorder is collective frustration. Orderly cooperation augments the power and freedom of the individual. The essence of freedom is that it can survive only if it is based on order.

Science can become the most important tool for democratic reorganization, but not if it remains half-heartedly used and socially irresponsible, and not if leading scientists sow distrust of government and remain squeamishly aloof from it. The Bush group, in effect, not only deny that government has the responsibility to assist in organizing science for human welfare, but they deny even that the scientists have that responsibility. For they would leave the laissez-faire tradition of science essentially intact and would perpetuate the isolation of science from the swirling current of human life. Above all, by debarring the full implementation of scientific method in democratic government, they would actually hasten what they most fear, namely, ill-considered, makeshift extension of government power.

In the age of the atom bomb, horse-and-buggy government is not merely an anachronism: it is a crime. To deprive government of the powerful tool of scientific method in reorganizing human relations, through law, administration, and cooperative social organization, would indeed condemn human society to remain in an "endless frontier" of force and chaos.

The Science Teacher and Legislative Proposals for the Promotion of Science

Frank E. E. Germann

University of Colorado and Executive Secretary, Southwestern Division, AAAS

THE NOTABLE SUCCESS of the Office of Scientific Research and Development in coordinating and originating scientific studies during our recent crisis has made our entire population conscious of the value of research. The report of the Director, Dr. Vannevar Bush, to President Truman, entitled *Science, the endless frontier,* has served as a framework of a bill (S. 1285) introduced by Senator Magnuson at the first session of the 79th Congress. The purpose of this bill and those of Senators Kilgore, Johnson (Colorado), and Pepper (S. 1298), Senator Fulbright (S. 1248),[1] Senator Byrd (S. 825), and Representative May (H. R. 3440) is to attempt to carry over to peacetime the advantages of a national research program. The National Research Council, organized during World War I, has announced the extension of its activities to the granting of Predoctoral Fellowships in the Natural Sciences while continuing its program of Postdoctoral Fellowships. The Research Corporation of New York will devote $2,500,000 during the next five years to support of research in chemistry, physics, mathematics, and their applications, such as engineering. The grants are to be made to institutions and are to be used to support the research work of persons of proven research ability who are desirous of entering, or re-entering, the faculties of institutions of learning. "Professional salary of the applicant must be borne by the institution as well as responsibility for continuation of the professional opportunity of the applicant beyond the terms of the grant."

Whereas all of the above programs should prove of great value to the stimulation of research, they fail to bring aid to the men under whom research is to be conducted. *No stream can rise higher than its source.* For many years the most competent research workers and teachers have been enticed away from educational institutions by our large industrial corporations, which have been able to pay salaries commensurate with the abilities of the men. A small number of our highly-endowed educational institutions have been able to hold and attract outstanding scholars because of their higher salary scales, but the average private or state-supported institution has been forced into mediocrity. The success which these have achieved is the result of a number of factors reflecting no credit on the institutions. Among these factors the following may be mentioned:

---

[1] Since this was written these latter bills have been combined into one S. 1720 (see *Science*, 1946, 103, 10; 39–44), but the cogency of Dr. Germann's comments is in no way weakened by this event. Ed.

(1) Because of his own health or that of a member of his family, a teacher may be forced to remain in a given climatic environment, regardless of salary.

(2) Because of a personal fortune, the teacher is free to work where he chooses.

(3) In order to live on the limited salary offered by the institution of his choice, the teacher may refrain from marrying and thus avoid financial obligations.

(4) A married teacher may refrain from, or postpone, having a family because of the low salary received.

(5) The teacher may also follow the European plan of marrying wealth.

(6) The family may scale its standard of living far below that which would seem to be appropriate to the profession.

(7) The wife may also have to be a breadwinner.

No one will deny that the conditions cited above do exist, and that they drag down the very group of society which in the final analysis has produced the vast body of educated and highly skilled scientists used as raw material by the OSRD in the task of winning the scientific aspects of World War II. Universities have the definite obligation of training men to enter the research laboratories of industrial organizations, but they also have an obligation to train men for the teaching profession. If this latter responsibility is not met by making university teaching financially more attractive, the quality of the product will of necessity deteriorate. In the long run, industrial laboratories are bound to suffer. The situation has been serious for many years, but the recent high level of wages paid to boys and girls graduating from high schools has served to bring the matter to a head. When many college and university positions pay only $1,500 to $2,000 to persons with doctorate degrees, is there any wonder that competent persons cannot be found to fill them? Even now, when the war is over, we are still able to place women just receiving the baccalaureate degree in chemistry, in industrial positions at $200 per month!

What future can we promise young men and women holding pre- and postdoctoral fellowships at $1,800 to $3,000 when we still offer $2,000 for assistant professors and require that they have the doctorate degree? What chance do we have to secure competent teachers in science when a full professor, after thirty years of service, may never reach a salary of $4,000? Intelligent young men should hesitate to make the sacrifice, knowing they will be better able to provide for their families if they choose the industrial offers which in a few years may bring them salaries of $10,000 or more. Recently a request was received from a university asking us to recommend someone holding both the M.D. and the Ph.D. degrees. The salary was $2,000, and the apology was added that this offer was being made in the hope that someone not actuated by financial needs might be willing to accept. What a travesty on justice! How long shall such conditions prevail? Shall universities continue to base salaries on individual needs or the minimum for which men will work, rather than on what they are worth in a competitive labor market? Should not a teacher be judged to be worth as much as his students. If not, why keep the teacher?

It is probably too much to expect to ask American industry to do something in the way of subsidizing professional salaries in our educational institutions so as to make these positions at least as lucrative as equally skilled industrial workers. However, the writer is convinced that such a move would, in the long run, reap handsome dividends for the donors. Such an undertaking, sponsored by the Federal Government, and possibly financed from excess profits taxes, would not seem to be unreasonable, because it would be returning only a small percentage to the teachers who had made corporation profits possible.

Some plan to accomplish the above end should be incorporated in one of the bills now before Congress or in some compromise bill resulting from the recent hearings. No plan yet proposed can hope to raise the level of scholarly achievement as much as can be accomplished by placing college and university teaching on a plane where the teachers will no longer have to apologize for their inability to go to scientific meetings, to take vacations, to care for the health of the family, and to do all those things which are expected of them by society.

Scanning Science—

Dr. David Starr Jordan was elected President of the California Academy of Sciences at its recent annual meeting.

—24 January 1896

Scientific Training

Howard A. Meyerhoff

Executive Secretary, AAAS, Washington, D. C.

In his recent radio address to the nation, President Truman gave more attention to the things Congress is not doing than to the things which are getting done. Scientists may take their cue from the President and give thought to one vital question to which altogether too little consideration has been given, namely, the replacement of scientific and engineering personnel lost during the war years.

The question is critical. Many scientists were drafted—commonly late in the war period after the use for their skills was no longer urgent and deferments were cancelled. Numerically, the most serious losses were caused by the drafting of 18-year-olds who would have entered the colleges and technological schools. Some of these men may undertake belated training when they are discharged from military service, but many will not. Meanwhile postwar projects lag for lack of men to handle the technological problems involved. Meanwhile, too, the nation is fast losing to other far-sighted countries the technological pre-eminence which was a major factor in victory.

Congress cannot be criticized for not attending to this problem, much less solving it, for scientists themselves have done little about it. The American Chemical Society tried, with only a little help from other organizations, to obtain deferment for new recruits in essential scientific fields. One bill was introduced into Congress (H.R. 2827) to achieve this purpose, but it died in committee. Our scientific personnel, both actual and potential, was expendable, but unlike expendable military personnel, no one assumed any responsibility for replacing it.

Now, five months after hostilities have ceased, the situation is unchanged. Selective Service, though it may defer students who are partially trained in scientific and technological fields, encounter few 18-year-olds in that category. Universal military service, as proposed, will continue the same indiscriminating policy, if adopted. The shortage of scientists and engineers, though it may be partially offset by returning veterans, will be increased rather than corrected.

During the past few weeks representatives of the engineering societies, the physicists, chemists, and the Association have met to consider corrective measures. The drain of trained or partly trained men has been checked but not stopped. It is now imperative to correct the deficit through immediate changes in Selective Service and through specific provisions in the Universal Military Service bill, if the latter is adopted. It may be just as vital to insure replacements of scientific and technological students if Universal Military Service is not adopted.

As a basis of immediate action twelve organizations phrased a resolution which contains a program adaptable to Selective Service and to Universal Military Service if passed. With some modification it can be effectively utilized if Universal Military Service is rejected. Indeed, the unique importance of science and technology in war and peace has prompted the suggestion by one Senator with whom the program has been discussed that the resolution may be the only program which can effectively prepare us at once for the grim requirements of war and the expanding needs of peace.

Twelve organizations have endorsed the resolution:

The American Association for the Advancement of Science
The American Ceramic Society
The American Chemical Society
The American Institute of Electrical Engineers
The American Institute of Mining and Metallurgical Engineers
The American Society of Civil Engineers
The American Society of Mechanical Engineers
The Electrochemical Society
The Engineers Council for Professional Development
The Engineers Joint Council
The Engineers Society of Western Pennsylvania
The Institute of Radio Engineers

They are sure others will recognize its importance and will want to take similar action. It is published herewith for the consideration of scientists and scientific societies that recognize the gravity of the current situation and foresee the still more serious problems of the future.

WHEREAS national security and public welfare are dependent upon and vitally affected by the quality of scientific, engineering and technological research, both fundamental and applied;

WHEREAS fundamental and applied research are entirely dependent upon ample reserves of trained and experienced manpower;

WHEREAS the ranks of scientists and engineers have been seriously depleted since 1941 by the requirements of military service;

WHEREAS the normal flow of students into the colleges and the engineering, technical, and graduate schools has almost completely ceased during the period from 1941 to 1945;

WHEREAS the alarming deficit in highly trained technical personnel will be further increased if Selective Service is continued without full recognition of the fact that technical personnel is as vital to national security and welfare as military personnel;

THEREFORE BE IT RESOLVED that the imperative and immediate need of replenishing scientific and engineering manpower be called to the attention of the President and the Congress;

BE IT FURTHER RESOLVED *that the Congress* be asked to take prompt legislative steps to insure a flow of scientific and engineering personnel through the colleges and the engineering, technical, and graduate schools adequate to national security and the public welfare;

BE IT FURTHER RESOLVED that such legislation as may be required be based upon principles consonant with the democratic methods embodied in Selective Service and with the tested methods of the institutions of higher learning; that to this end the following provisions be incorporated in such legislation:

1. Young men who have attained their eighteenth (18th) but not their twenty-sixth (26th) birthday shall be allocated to the colleges, universities, and technical schools after induction rather than through deferment;

2. Such men should be chosen by recognized and established selective processes, as far in advance of induction as possible;

3. The selection of these men should be administered by the appropriate government agency, which shall determine from year to year the number of young men who may be admitted to the training program, so as to bring the total anticipated output of trained personnel at least to prewar standards;

4. The young men so selected shall be assigned to accredited colleges and institutions of their own choice;

5. Such colleges and institutions shall not be obligated to impose on these students any requirements other than those normally imposed upon civilian students; but no provision contained in this plan shall exclude said students from enrolling voluntarily in reserve officer training programs maintained by the Army and Navy in the institutions in which they enroll;

6. The duration of the training period shall be identical with that designated in the Selective Service training program; the academic calendar for training shall not exceed nine months in any one year, the remaining three months being available to the Army or Navy for military training;

7. Financial support for trainees during this period shall not exceed that awarded to trainees under the Servicemen's Readjustment Act (Public Law 346);

8. Failure on the part of any trainee to meet the scholastic requirements of the institution to which he is assigned shall result in immediate transfer to regular military duty;

9. Trainees admitted to this program shall be subject to the same obligations for subsequent public service as may later be incorporated in a plan of national scholarships and as applied to a training period of equal length;

BE IT FURTHER RESOLVED that the acute shortage of scientific and engineering personnel in the colleges, in government agencies and in industry be immediately alleviated by adoption of those provisions of the Vannevar Bush report (*Science, the endless frontier*) relating to the release of scientists and engineers now in the armed forces; and

BE IT FINALLY RESOLVED that full cooperation of the legislative and executive branches of the Federal Government be solicited, not only in the implementation of this emergency program which is designed to correct the deficit (now estimated at approximately 150,000) of scientific and technical students, but also in assuring a future supply of trained manpower, adequate in numbers and in skill to meet the involved problems of national progress, welfare, and security.

Technical Papers

The Anemia Associated With Chronic Infection[1]

G. E. Cartwright, M. A. Lauritsen, S. Humphreys,
P. J. Jones, I. M. Merrill, and M. M. Wintrobe

School of Medicine, University of Utah

A study of the anemia accompanying such chronic conditions as empyema, osteomyelitis, endocarditis, and various other chronic infections in humans has revealed a rather characteristic chemical pattern. There is a pronounced hypoferremia which is accompanied by hypercupremia, an increase in the erythrocyte protoporphyrin and coproporphyrinuria. These results are briefly summarized in Table 1. Only male patients were used in the study. Morphologically the anemia was found to be normocytic, or slightly microcytic and slightly hypochromic.

TABLE 1

Summary of the Chemical Characteristics of the Anemia Associated With Chronic Infection

	Plasma Iron γ %	Serum Copper γ %	Erythrocyte protoporphyrin γ/100 cc. RBC	Urinary coproporphyrin γ/24 hr.
Normal				
No. of cases .	20	25	10	22
Average value	120	116	80	106
Chronic infections				
No. of cases .	19	11	19	14
Average value	29	220	175	278

The administration of iron by mouth to these patients was associated with no significant increase in the content of iron in the plasma, in sharp contrast to the finding in normal persons. Intravenous administration of iron was associated with a rise in the plasma iron level of somewhat smaller degree than occurs normally and a return to preinjection levels which took place much more rapidly than is normal. In these respects the anemia associated with chronic infections is similar to the anemia of iron deficiency. Hypoferremia, hypercupremia, and an increase in erythrocyte protoporphyrin are also common to both conditions. Unlike iron deficiency anemia, however, the anemia of infection does not respond to either oral or intravenous iron therapy. We have been unable to obtain evidence that the anemia associated with infection is hemolytic in nature or that there is a defective synthesis of either globin or protoporphyrin.

This evidence may be interpreted as indicating that there is a failure to form heme because of lack of sufficient iron to incorporate into the protoporphyrin molecule. As a result, protoporphyrin and copper are not utilized, and their quantity increases, awaiting the time when iron will be made available so that the formation of heme may proceed at its normal rate.

To investigate more completely the pathogenesis of this anemia, intramuscular staphylococcal abscesses were produced in 3 adult dogs. The plasma iron level dropped precipitously from levels of 150 to 275 micrograms per cent to levels of 15 to 30 micrograms per cent in 48 hours. This was followed in approximately 15 days by the development of moderate anemia. By this time the plasma iron level had returned to normal. This stage was followed shortly by clinical improvement and disappearance of the anemia. The intramuscular injection of staphylococcal toxin or typhoid vaccine produced less definite changes. The intramuscular injection of sterile turpentine into 16 dogs produced a sharp fall in plasma iron within 48 hours in all of the animals. A second injection of turpentine was followed by the development of a moderate degree of anemia. This indicates that neither bacteria nor their toxins are essential for the production of hypoferremia and suggests that an inflammatory reaction *per se* is capable of producing this change. We are unable to state with certainty whether a specific substance is elaborated by an inflammatory reaction. The intravenous injection into each of 7 dogs of 50 ml. of sterile pleural fluid, obtained following the intrapleural injection of turpentine, resulted in a suggestive, but not a profound, lowering of the plasma iron.

Menkin (*1, 2*) has shown that there is an accumulation and fixation of iron in inflammatory tissue. Schäfer (*3, 4, 5*) has demonstrated that there is an increased iron retention in febrile conditions in children and that during mild infections in mice iron accumulates in the reticulo-endothelial system. On the basis of these observations, together with the data we have presented in humans and in dogs, it now seems possible to outline a working hypothesis for the pathogenesis of this anemia.

According to this hypothesis, as a result of an inflammatory reaction, iron is diverted to the tissues and is not made available for hemoglobin synthesis. As a consequence of this increased demand of the tissues for iron, the removal of this element from the blood stream is hastened and possibly its absorption from the bowel is even increased. Because iron is not made available for use by the bone marrow, the reaction

---

[1] The work described in this paper was carried out under a contract recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the University of Utah.

$$\text{Protoporphyrin} + \text{Iron} \xrightarrow{Cu^{++}} \text{Heme}$$

cannot proceed and anemia develops.

The fault in iron metabolism cannot be corrected by the administration of iron. This is probably because of the persistent and urgent demand for iron to fulfill some function in relation to infection, which has a greater priority for iron than hemoglobin formation.

These experiments are to be reported in detail in the near future.

References

1. MENKIN, V. *J. exp. Med.*, 1930, **51**, 879.
2. MENKIN, V., and MENKIN, M. F. *J. exp. Med.*, 1931, **53**, 919.
3. SCHAFER, K. H. *Klin. Wschr.*, 1940, **19**, 979.
4. SCHAFER, K. H. *Z. ges. exp. Med.*, 1942, **110**, 678, 697, 713. (In *Chem. Abstr.*, 1944, **38**, 2384.)
5. SCHAFER, K. H. *Klin. Wschr.*, 1943, **22**, 98.

An Observation on the Red Cell Content of the Blood of the Thoroughbred Horse[1]

JOHN MACLEOD
Cornell University Medical College

ERIC PONDER
The Nassau Hospital, Mineola, New York

While making observations of the blood of the horse, we noticed consistent differences between the thoroughbred and the cold-blooded horse with regard to the red cell count per cubic millimeter and the hemoglobin content in grams per 100 ml. of blood. The average values obtained in the thoroughbred animal have also a relation to age, as is shown in Table 1, which includes standard errors and average values for the mean corpuscular hemoglobin.

TABLE 1

Group	Number in group	Red cells millions/mm.^{3}	Hemoglobin grams/100 ml.	Mean corpuscular hemoglobin, γγ
Thoroughbreds				
Foals	8	12.91 ± 0.78	13.86 ± 0.31	10.7
Yearlings ..	12	12.50 ± 0.74	14.13 ± 0.46	11.3
2–3 years ..	12	10.80 ± 0.25	14.10 ± 0.46	13.1
Older horses.	8	11.55 ± 0.74	15.37 ± 0.78	13.3
Cold-blooded horses	10	7.94 ± 0.28	12.63 ± 0.33	16.0

The differences between the means of the red cell counts of the two- to three-year-old horses and those of the foals and of the yearlings are significant, as also is the larger difference between the means of the counts of the two- to three-year-olds and those of the counts of the cold-blooded horses.

Table 1 shows that the red cell count and hemoglobin content in the thoroughbred are higher than the count and hemoglobin content in the cold-blooded horse, the red cell count for which is usually given as between 6 and 8.5 million.[2] At the same time the quantity of hemoglobin per cell is smaller. Table 2, which gives the average hemoglobin content, mean cell volume, and mean corpuscular hemoglobin concentration in 5 thoroughbred and 5 cold-blooded horses, shows that the cells of the thoroughbred carry less hemoglobin per cell because the cells are a little smaller and because the hemoglobin concentration is a little less. The thoroughbred, nevertheless, carries more hemoglobin per milliliter of blood than does the cold-blooded horse because there are more red cells per unit volume.

TABLE 2

	Thoroughbred	Cold-blooded
Red cells, millions/mm.^{3}	10.35	8.21
Hemoglobin, grams/100 ml.	13.89	12.06
Mean cell volume, μ^3	42.2	43.6
Mean corpuscular hemoglobin concentration, per cent	32.7	33.5
Mean corpuscular hemoglobin, γγ	13.4	14.7

This combination of an increased red cell count, a decrease in red cell volume, a decrease in mean corpuscular hemoglobin concentration, but an increase in the hemoglobin content per milliliter of blood, is met with in animals (rabbits) subjected to low atmospheric pressures (*1*) and in other states in which the bone marrow is hyperactive, such as polycythemia vera in man. Since it is most improbable that thoroughbred horses suffer from an oxygen lack sufficient to keep their bone marrows in a state of hyperactivity, the higher red cell counts and hemoglobin contents in the blood of these animals is probably a genetic characteristic, as polycythemia sometimes is in man. The probability of the genetic explanation being right is increased by the fact that the high red cell counts are present at birth and are maintained in the weanling, yearling, and ensuing age periods. The elevated counts are therefore not the result of training or conditioning processes which prepare the animal for racing. It may very well be, of course, that the increased hemoglobin content and slightly smaller cell size confer an advantage on the thoroughbred when running at high speeds, and so these may be characteristics which have become accentuated in the process of the "improvement of the breed."

Reference

1. DUBIN, M. *Quart J. exp. Physiol.*, 1933, **23**, 31.

---

[1] This study was made on the horses of Col. C. V. Whitney, to whom we are indebted for his courtesy. The expenses of the investigation were defrayed by the Grayson Foundation.

[2] Several references are given in Appendix A of Wintrobe's *Clinical hematology* (Philadelphia: Lea and Febiger, 1942).

Fur and Feathers: A Response to Falling Temperature?[1]

RAYMOND B. COWLES
University of California, Los Angeles

At the present time it seems to be generally conceded that "the appearance of fur and feathers in birds and mammals came in response to a need for some mechanism for heat conservation," and that mutations in the direction of these dermal coverings survived owing to the advantages of heat or energy conservation conferred upon the possessor of these new insulating features. Aside from the fact that necessary mutations give no evidence that they ever develop in response to a need, this Lamarckistic conclusion seems dubious for the following reasons:

(1) All the available evidence strongly suggests that the mechanism of heat regulation, which is closely associated with the warm-blooded state and is essential for that condition, has appeared as a comparatively late evolutionary acquisition. In the field of phylogeny we observe the phenomenon of a succession of steadily ascending body temperatures, culminating in what are assumed to be approximately the most specialized, warm-blooded creatures. It is interesting, and possibly no coincidence, that the morphological structures on which we base phylogenetic position in birds and mammals should also accompany the physiological trait of successively higher temperatures. The record is not perfect, that is, there are occasional exceptions to the rule, but in general there is a thermal ascent accompanying the morphological specializations in these groups.

(2) In the field of embryology as in phylogeny we find evidence which similarly suggests that thermal regulation and the development of warm-bloodedness is an apparently recent acquisition in the development of organisms. Although the interpretation of this situation might be ascribed to several possibilities, it seems most reasonable to conclude that thermal regulation and warm-bloodedness must have arrived fairly late in the evolutionary process, probably long after fur and feathers made their appearance.

The third point militating against the acceptance of the current speculations concerning the origin of fur and feathers is fairly simple.

If warm-bloodedness is of fairly recent origin, then we must assume that the early, prototypal forms which gave rise to feathered and furred creatures were probably cold-blooded. If cold-blooded, they were definitely ectothermic in nature, that is, they derived their chief source of heat from outside of the body in direct contrast to the later warm-blooded or endothermic types in which temperatures are chiefly a result of metabolic activity, often made possible by a prodigious expenditure of energy.

In so far as we know, all ectothermic animals (with the exception of colonial types, such as the bees) for all practical purposes are wholly dependent upon outside sources for their body heat and all these types become lethargic, even comatose, in the presence of falling temperatures. The naked skin of reptiles expedites the absorption of solar energy, and to interpose a barrier such as fur and feathers between the heat source and the body would seem to be impractical from the survival standpoint, except under conditions of high or increasingly great incidence of solar radiation. Survival is difficult at best, and adjustment to the environment is usually rather precisely arranged —as witness the fate of most mutants. It is true that radiant heat will penetrate through fur and feathers, and therefore that the possessor of these insulating coats could absorb some of the heat from outside of the body in spite of this barrier, but on the other hand, survival in a cold-bloded form could hardly be fostered by the development of any handicap to maximum efficiency in heat absorption, particularly if temperatures in the environment were dropping.

If fur and feathers developed under conditions that, but for their presence, would have produced injury due to increases in the intensity of solar radiation, we would expect to find the interposition of an insulating covering a highly beneficial novelty having real survival value. By high temperature or rising temperature the reference point is, of course, that of the animal's limits of thermal tolerance and not temperatures as we may know them today.

The possession of a mechanism that would slightly retard accessions of heat would extend the total number of minutes or hours of diurnal activity, especially toward mid-morning, that might be available to a foraging animal. Such a coat would also enable the animal to extend its mid-day excursions into the sunshine for longer periods of time due to this protection against rapid overheating. Toward evening, or after excursions into the open and subsequent return to shade or to burrows, the presence of this radiation excluding mechanism would have a reverse effect, that is, it would retard the loss of heat and would thus extend the animal's postwarming periods of activity.

For these reasons it seems more logical to conclude that mutations producing fur and feathers were originally retained because of their function as a device that could retard the absorption rate of excessive solar radiation. Later on, their possession permitted the gradual development of temperature control necessary for the development of warm-blooded animals.

Without an already acquired insulating coat, it is difficult to understand how energy-expending, internally heated systems could have survived in a cooling environment. This use for insulation must be a fairly recent innovation because even the more primitive, less specialized mammals still show a tendency toward ectothermism (poikilothermism) while many of the most highly specialized thermal animals, the birds, do not acquire complete endothermism (homeothermism) until some time after hatching.

---

[1] Revision of a concept originally stated in: R. B. Cowles, *Amer. Nat.*, 1940, **74**, 559.

This analysis presents another example in which it can be argued that rising or high temperatures may have played a dominant part in evolution.

In the Laboratory

Semi-continuous Tap-water Aerator[1]

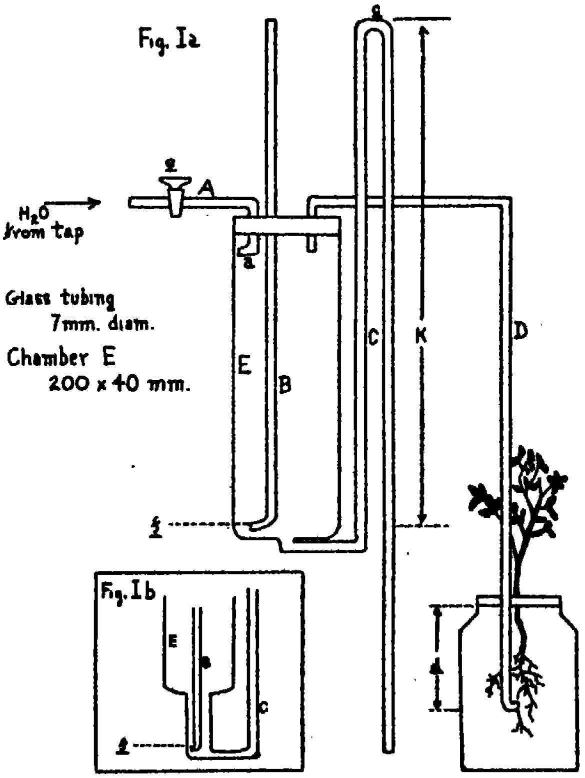
E. C. Cantino and E. D. Hatfield
University of California, Berkeley; Hercules, California

For many species, the water culture method for growing plants requires continuous aeration of the nutrient solution. By this means, the root system is maintained at an oxidative level favorable for active growth and metabolism.

In the greenhouse and in most laboratories, the source of oxygen is generally an air compressor, from which a continuous supply for the aeration process is readily obtainable. In the event that a compressor is not available, an alternative source of air is required.

The apparatus described herein has been constructed from common inexpensive glassware and requires a minimum of space. A trap or filter for oil spray and other contaminants commonly found mixed with air derived from a compressor is unnecessary because the source of such foreign material is eliminated. The quantity of water used per day for production of a moderate stream of air (approximately 10 cc. per minute) is usually in the neighborhood of four gallons or less. Results indicate that a relatively high efficiency and low cost of operation are characteristic of this equipment.

The apparatus is illustrated diagrammatically in Fig. 1a. Tap water is forced through A into chamber E, open to the atmosphere only through tubes B and C, and dropwise rate of water flow is regulated by stopcock *e*. Air is initially displaced from the chamber through B until water approaches level *f*. Subsequently, aeration of the solution commences after the pressure due to the head of water *d* has been overcome. When water has risen to level *c* in the siphon tube, it is automatically removed from chamber E by a siphon mechanism through C. During this short interval, aeration ceases. When the chamber has been emptied, the cycle is repeated and aeration continues. Water inlet tube A and tube B are bent toward the side of chamber at *a* and *f* in order to avoid spattering at the bottom of tube C during the siphoning interval and, consequently, to minimize introduction of excess air bubbles into tube C which affects the continuity of fluid in C. A highly porous, fritted glass disperson disc may be used for more effective gas distribution at the terminal end of the aeration tube, D. However, it has been determined that a low porosity tube introduces some difficulty. The magnitude of the frictional resistance to gas flow offered by such material results in an undesirable increase in the total pressure which must be exerted by the expanding gases in E to overcome the gross resistance in the system.



The time interval between intermittent aeration can be minimized by designing the apparatus so that the time required for removal of water from E is small as compared to the time necessary for liquid in C to reach level *c*. Although the dimensions of chamber E (Fig. 1a) are satisfactory for aeration of plant root systems, the time interval between cessation of siphoning and production of a closed system in E upon reaching level *f* can be reduced if continuous aeration is desirable for some other purpose. This can be accomplished by constructing the chamber as shown in Fig. 1b. The advantage of a slight increase in efficiency is consequently attained at the expense of a more elaborate design, which decreases to some degree the simplicity of the original apparatus.

---

[1] The authors wish to express their appreciation to T. C. Broyer for helpful suggestions and criticisms with this paper, which was written while the senior author was located in Pasadena, California.

It has been found that, in order to maintain the described continuity in the rate of aeration with the apparatus in Fig. 1a, the relationship between height K of siphon tube C and head of water *d* to be overcome in the culture tank can be formulated by the following approximation: $K = 2.2d$. Obviously, this relationship is only applicable if the dimensions of chamber E and diameter of glass tubing used are equivalent to the specifications outlined in Fig. 1a.

The aeration equipment described in this paper was constructed with siphon tubes of several dimensions and used successfully for aeration of culture solutions of various depths. The apparatus has been used continually for periods of more than thirty days at one time, and with the exception of occasional minor adjustments of the rate of water flow due to slight fluctuations in the pressure of the main water supply, no difficulty was experienced.

Prozones and Blocking Effect in Normal Iso- and Hetero-Agglutination With Cord Sera

Herbert H. Lubinski
Jewish General Hospital, Montreal, Canada

Wiener (*2*) has recently described a blocking test for Rh sensitization as a method to detect specific antibodies in anti Rh sera, which otherwise fail to demonstrate the usual *in vitro* agglutination phenomena. He has also demonstrated that these blocking antibodies are the cause of the prozone phenomenon, which may be observed, not infrequently, in anti Rh agglutination.

Using the blocking technique, Levine and Gilmore (*1*) were able to obtain a blocking effect with the serum derived from a patient suffering from infectious mononucleosis in which the Paul Bunnel reaction was negative. The effect was quite analogous to that observed in Rh negative mothers of erythroblastotic infants.

The opportunity presented itself to the writer to test the relation of blocking antibodies to the prozone phenomenon in normal iso- and hetero-agglutination. During a study on cord sera four sera were found among several hundred which showed a more or less marked inhibition zone. These sera, which had been stored at refrigerator temperature for 2 to 3 weeks, were used to search for the presence of blocking antibodies. The sera were all group O.

Technique: Previously unheated serum (0.2 cc.) was diluted in increasing amounts with 0.2 cc. of saline and 0.1 cc. of a 2.5 per cent suspension of thrice-washed red cells added. The mixture was shaken well and centrifugalized for 2 minutes at a speed of 1,200 rpm. A first reading was then made, to see if an inhibition zone was present. After renewed centrifugalization the supernatant fluid was withdrawn and replaced by a type-specific serum diluted to such a degree that it still gave a 4 + reaction with the red cells used in the experiment. The tubes were then thoroughly shaken, centrifugalized a third time and readings made. Two tests were done with A and B cells, respectively, and two with rabbit cells. The results are given in Table 1. They show that in the prozone the added serum could not achieve a complete agglutination, whereas in the highest dilutions 2 + and 1 + reactions as well as the negative were changed to 4 +, thus demonstrating a blocking effect of the tested cord sera.

TABLE 1
SERUM—DILUTION

Serum	Red cells	undil.	1/2	1/4	1/8	1/16	1/32	Nature of test
1652	B	–	–	±	3 +	2 +	±	Direct titration
		1 +	2 +	4 +	4 +	4 +	4 +	Blocking
1818	A	1 +	2 +	4 +	4 +	2 +	1 +	Direct titration
		1 +	8 +	4 +	4 +	4 +	4 +	Blocking
1819	Rabbit	–	2 +	4 +	4 +	3 +	1 +	Direct titration
		2 +	4 +	4 +	4 +	4 +	4 +	Blocking*
		±	2 +	4 +	4 +	4 +	4 +	Blocking†
1863	Rabbit	1 +	2 +	4 +	4 +	3 +	1 +	Direct titration
		1 +	2 +	4 +	4 +	4 +	4 +	Blocking

* Testing serum diluted 1/2.
† " " " 1/32.

The question as to the nature of the blocking antibodies is still open to speculation. Wiener regards them as "an antibody having the capacity of combining with the sensitive cells without producing a visible reaction. After proper absorption the serum may give a positive agglutination reaction." One may think of an agglutinoid, *i.e.* an agglutinin which has lost the agglutinating part and consists of the haptophore group only, similar to the relation of toxin and toxoid. However, another explanation may be that the blocking antibodies are identical with the hemolysin, which combines with the same cell receptor as the agglutinin. This theory assumes, of course, that agglutinins and hemolysins are different antibodies. Whatever it may be, it must have a greater avidity for the red cells than the agglutinin.

However, in the cases described above another possible explanation has to be considered for the following reason. It was found that the prozone phenomenon, which was observed on unheated sera, disappeared and was replaced by a 4+ agglutination, when the sera were previously heated for 30 minutes at 56° C. Since the tests were made after the sera had been kept in the refrigerator for 2 to 3 weeks, complement can be excluded as the cause of the prozones. It may therefore be possible that a heat-labile substance is present in cord sera which is responsible for the prozone phenomenon and the blocking effect with this type of sera.

Therefore, it seems that the inhibition zone as well as the blocking effect can be caused by different agents.

References

1. LEVINE, PH., and GILMORE, E. L. *Science*, 1945, **101**, 411.
2. WIENER, A. S. *Proc. Soc. exp. Biol. Med.*, 1944, **56**, 173.

News and Notes

Dr. Mark W. Woods has rejoined the staff of the Department of Botany at the University of Maryland after three years in the Armed Forces. He began his duties as associate professor of plant pathology on 1 December 1945.

Dr. Hyman I. Goldstein, Camden, New Jersey, has been appointed professor of the history of medicine, Essex College of Medicine and Surgery, Newark, New Jersey, and will deliver weekly lectures.

Dr. Harold Blum, of the U. S. Public Health Laboratory, Bethesda, Maryland, conducted a special conference at the University of Texas Medical Branch, Galveston, on the "Influence of Sunlight on Carcinogenesis," on 8 January. Dr. Blum has recently been awarded a Guggenheim Fellowship for the study of thermodynamic factors in evolution.

Dr. Donald Duncan, professor of anatomy at Louisiana State University Medical School, New Orleans, has accepted an appointment as professor of anatomy and chairman of the Department of Anatomy at the University of Texas Medical School, Galveston, and will assume his new post on 1 February.

Dr. Henry R. Kreider has been appointed chief chemist of The Wm. S. Merrell Company, Cincinnati, Ohio.

Dr. Richard J. Lund, mineral economist, geologist, and one-time director of the Miscellaneous Minerals Division of the War Production Board, has joined the staff of Battelle Institute, Columbus, Ohio. Prior to his three-year association with WPB, Dr. Lund served as consultant on miscellaneous minerals to the old Office of Production Management and Defense Commission, and earlier was for three years (1937–1940) editor of the *Mining Congress Journal.*

Col. James A. Tobey was decorated on 4 December 1945 with the Ordre de la Santé Publique, grade of Officier, by the French Republic. The presentation was made in Stuttgart, Germany, by Inspecteur General Coulon. Col. Tobey returned on 24 December to his home in Rye, New York, after two years and eight months service overseas, the last seven months as Deputy Military Governor of Wurttemberg-Baden in Germany.

Dr. Robert Simha has become a member of the Division of Organic and Fibrous Materials of the National Bureau of Standards, with special responsibility for the coordination of fundamental research on the molecular properties of high polymers.

Dr. Hugh L. Dryden has been appointed assistant director of the National Bureau of Standards. His services in this capacity will supplement those of Mr. E. C. Crittenden, who has served as assistant director for many years and who will continue in that capacity.

Dr. Ferdinand G. Brickwedde has been designated chief of the Heat and Power Division of the National Bureau of Standards, succeeding Dr. H. C. Dickinson, who retired on 31 October. Dr. Brickwedde has been with the Bureau since 1925.

Frederick S. Bacon, chemical research consultant, announces the formation of a partnership with Philip D. Wilkinson under the name of Frederick S. Bacon Laboratories. The new firm will continue the chemical research and consultation business established in 1939 at the present location, 192 Pleasant Street, Watertown, Massachusetts.

Dr. Harry J. Klepser, formerly of the faculty of South Dakota State College, and more recently a member of the U. S. Geological Survey, has been appointed assistant professor in the Department of Geology and Geography at the University of Tennessee.

Luther S. West, Major, Sanitary Corps, AUS, has been released from active service with the armed forces and will resume his duties as Chief of the Division of Natural Sciences, at Northern Michigan College of Education, Marquette, Michigan. For the past two years Dr. West has served as Chief of Medical Entomology, in the Division of Parasitology at the Army Medical School, Washington, D. C.

Dr. Milton Harris, director of research, Milton Harris Associates, Washington, D. C., was awarded the Olney Medal at the annual banquet of the American Association of Textile Chemists and Colorists held Saturday, 5 January 1946 at the Hotel Pennsylvania, New York. The award, which is made by the AATCC for outstanding achievement in the field of textile chemistry, is named in honor of Dr. Louis A. Olney, president emeritus of the association. In accepting the medal, Dr. Harris said: "In a broad sense, the technical problems of the textile industry are basically the same as those in all industries; they involve the harnessing of a vast reservoir of scientific knowledge resulting from work in educational institutions, government laboratories, and industry. This knowledge does not stem solely from research in the field of textiles. It comes from work in the allied high-polymer field, whether it be on resins, rubbers, or plastics; it comes from work in chemistry, biology, medicine, or literally any field of science. . . . Contrary to popular opinion, the country is not going to be presented at this time with many revolutionary textile materials or fabrics. The war simply accelerated the lines of work indicated earlier, but it will take all of our postwar efforts to bring these developments to their successful conclusion."

Dr. Philip S. Winnek has resigned as director of research with the Pitman-Moore Company, Indianapolis, Indiana, to accept a position with the Research Department of the Commercial Solvents Corporation, Terre Haute, Indiana.

Dr. Ralph B. Bowersox, recently research associate at the Harvard Underwater Sound Laboratory, has been appointed associate professor in the Department of Physics and Astronomy at Michigan State College. In the same department, Dr. C. D. Hause has been named professor and Dr. J. W. McGrath, associate professor. Thomas H. Osgood is head of the department.

John C. Flanagan, Col., Air Corps, Army of the United States, was recently awarded the Legion of Merit for exceptionally meritorious conduct in the performance of outstanding service for the Army Air Forces. The presentation of the medal was made 8 January 1946 by Gen. H. H. Arnold. The citation read in part: "Col. Flanagan pioneered in the establishment and development of the Army Air Forces Aviation Psychology Program and by his ingenuity in directing psychological research, he contributed signally to the development of effective selection and classification procedures for Army Air Forces personnel, which has resulted in the improved utilization of manpower and the creation of a more effective striking force."

George M. L. Sommerman has been appointed associate professor of electrical engineering at Northwestern Technological Institute. From 1 June 1942 to 1 October 1945, he was on leave from the American Steel and Wire Company, serving as a senior engineer with Section T of the Office of Scientific Research and Development, and, later, with the U. S. Navy Bureau of Ordnance in Silver Spring, Maryland.

Stephen J. McDonough, Jr., Washington science editor of the Associated Press from 1933 to 1942, and more recently chief of the Planning Branch, Technical Information Division, Office of The Surgeon General of the Army, has joined the staff of *Modern Medicine,* Minneapolis.

Subrahmanyan Chandrasekhar, professor of theoretical astrophysics at the University of Chicago, has been awarded the Sir Cattamanchi Ramalinga Reddy National Prize for Mathematics by the Andhra University of India. The award, given annually for eminence in science, humanities, or fine arts, was presented to Prof. Chandrasekhar in recognition of outstanding merit in mathematics, pure and applied. He is the second to receive the prize, originated last year by Sir C. R. Reddy, chancellor of Andhra University.

Sir Henry Dale, O.M., F.R.S., will retire from his position as Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory on 30 September 1946, according to *The Times,* London. His successor in both posts will be Prof. Eric K. Rideal, F.R.S., professor of colloid science in the University of Cambridge.

Dean Joseph W. Barker, of the Columbia University School of Engineering, has been presented the Distinguished Civilian Service Award for his work as special assistant to the Secretary of the Navy in reorganization of the Navy's educational and training programs.

Announcements

The Lilly Research Laboratories, Indianapolis, Indiana, have made a grant of $2,500 to the University of Texas Medical Branch, Galveston, to establish a training fellowship in tissue culture, with special reference to the reticulo-endothelium system, under the direction of Charles M. Pomerat, professor of anatomy and director of the Tissue Culture Laboratory.

The Committee on Research in Endocrinology, National Research Council, announces that requests for grants-in-aid during the fiscal period from 1 July 1946 to 30 June 1947 will be received until 28 February 1946. Application blanks may be obtained by addressing the Secretary, Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, Washington 25, D. C. In addition to a statement of the problem and research plan or program, the Committee desires information regarding the proposed method of attack, the institutional support of the investigation, and the uses to be made of the sum requested. No part of any grant may be used by the recipient institution for administrative expenses.

The Committee makes grants in aid of research in the general field of experimental and clinical endocrinology. However, applications for support of research in the problems of sex in the narrower sense cannot be given favorable consideration, and investigators seeking support in this field should direct their proposals to the Committee for Research in Problems of Sex, of the National Research Council. The Committee on Research in Endocrinology will continue to give consideration to the support of studies of the effect of sex hormones on nonsexual functions, e.g. on general metabolism and on the metabolism of steroid hormones.

The National Foundation for Infantile Paralysis, Inc., has made a grant of $3,500 to the University of Texas Medical Branch to support the studies of Dr. A. Packchanian on virus transmission in small animals, in order to try to devise a rapid diagnosis procedure, and to assist in screening tests in therapy. Dr. Packchanian is director of the Laboratory of Microbiology at the Medical Branch.

To explore new scientific methods for measuring opinions and attitudes the National Research Council and the Social Science Research Council have jointly formed a committee of eighteen leading experts drawn from business, government, and universities. Creation of the Committee on the Measurement of Opinion, Attitudes, and Consumer Wants was announced by Dr. Ross Harrison and Dr. Donald Young, executive directors of the two councils, which represent the numerous associations of professional workers in mathematics, statistics, psychology, and the various social sciences.

Samuel A. Stouffer, professor of sociology at the University of Chicago, is chairman of the new committee with Samuel S. Wilks, professor of mathematics at Princeton University, as vice-chairman. Its conduct will be under the immediate direction of an executive committee including Drs. Stouffer and Wilks, Dr. Frank Stanton, of the Columbia Broadcasting System, and Dr. Rensis Likert, of the U. S. Department of Agriculture.

The other members of the committee are:

P. G. Agnew, The American Standards Association
Edward Battey, Compton Advertising, Inc.
Hadley Cantril, Princeton University
Archibald M. Crossley, Crossley, Inc.
W. Edwards Deming, The Bureau of the Budget
Robert F. Elder, Lever Brothers Company
George H. Gallup, The American Institute of Public Opinion
Philip M. Hauser, The Department of Commerce
Carl I. Hovland, Yale University
Paul F. Lazarsfeld, Columbia University
Darrell B. Lucas, New York University
Elmo Roper, New York City
Walter A. Shewhart, The Bell Telephone Laboratories
C. L. Warwick, The American Society for Testing Materials

At the initial meeting plans were discussed for a long-term program aimed at promoting the exchange of information and experience among workers in business, government, and the universities who are facing similar problems in developing increasingly efficient methods of measurement. The committee authorized its executive body to plan the establishment of subcommittees which will review progress to date in various related areas of research, conduct tests, and lay out the next steps in research which may be undertaken either under the committee's auspices or by independent workers. Investigations are to be carried on under the immediate supervision of the several subcommittees, by staff workers supported by the two sponsoring Councils. The general committee will review the results of their work from time to time and serve as a clearing house for current problems.

Millions of dollars are now being spent annually in commercial and government surveys employing sampling procedures. The last two decades have seen the development in this field of a large and intricate body of methods based on mathematics, psychology, and other sciences. A concerted attack on problems of sampling, questionnaire construction, and statistical analysis is expected to develop new and more economical ways of insuring the validity of findings, and to open up new fields in which these research tools can be usefully applied.

The Yerkes and McDonald Observatories of the University of Chicago announce the appointment of a new assistant director, Dr. W. A. Hiltner, who will also continue to serve as assistant professor of astrophysics. Dr. Gerard P. Kuiper, professor of astronomy, has returned to the Yerkes Observatory after an absence of more than two years, during which time he was connected with the Radio Research Laboratory of Harvard University. Dr. S. Chandrasekhar, professor of theoretical astrophysics, has returned to full-time work in astronomy at the Yerkes Observatory, after having served as part-time consultant at Aberdeen Proving Ground. Dr. Chandrasekhar was recently awarded the C.R.R. National Prize for mathematics by the Andhra University of India. Dr. D. M. Popper, instructor in astrophysics, has also returned after two years of war research at the Radiation Laboratory of the University of California. New appointments at the Yerkes Observatory include Dr. Wasley S. Krogdahl and Dr. William P. Bidelman, both instructors of astrophysics.

The New York Times reports that a Canadian military expedition by snowmobile, starting from Churchill on 14 February, will cover about 3,200 miles of Arctic country and finish in Edmonton on 5 May. The expedition will include 45 men of all ranks, together with a few United States experts, and will travel in 12 snowmobiles of a new pattern.

The route will be Baker Lake, where a meteorological station will be established; Cambridge Bay, over the top, and down past Norman Wells and Nelson. During the last part of the trip the snowmobiles will be called on to travel under different weather conditions, since it is expected that the ice breakup will have begun.

These vehicles, developed in Canada as an adaptation of the United States Army weasel, have wide tracks and have been proved capable of making a daily average speed of 35 miles in bad snow and ice conditions.

Defense Minister Douglas Abbott has stated that it is believed that the lessons learned will be of greater civilian than military value.

The Kerckhoff Marine Laboratory of the California Institute of Technology is again ready to receive applications for laboratory space from qualified investigators. No charge is made for research space. The Laboratory will be open throughout the year. Because of the housing problem, applications should be made well in advance. Address: G. E. MacGinitie, Corona Del Mar, California.

Preliminary discussions are being held looking toward the formulation of a definite building plan for the Fishery Biological Laboratory at Woods Hole, Mass. These discussions are continuing. Since a major reconstruction of the laboratory and its facilities is involved, it is necessary to give careful consideration to the long-term program which may be undertaken at Woods Hole, and to plan accordingly. When the Fish and Wildlife Service has reached a definite conclusion on these matters it will then be necessary to seek an appropriation from Congress in order to carry on the reconstruction.

A dictionary of American State names, some of which have origins quite different from those generally attributed to them, has been compiled by Dr. John P. Harrington, linguistic expert of the Bureau of American Ethnology, Smithsonian Institution. Originally published in the *Journal* of the Washington Academy of Sciences, many of the derivations after further investigation have now been revised.

An American Forestry Congress to formulate a postwar conservation program for the 630,000,000 acres of forest land of the United States will be held at Washington, in cooperation with national and state forest agencies and the forest industries, upon completion of the nationwide survey now being made by the American Forestry Association of the effect of war drains upon the forest resources of the country. The conference probably will be held in September, 1946. The survey, known as the Forest Resource Appraisal, has been in progress for the past twenty months. When completed, it will provide an analysis of the forest resources of the country after four years of total war.

A campaign to raise a five-year operating fund of $1,300,000 for the Southwestern Medical Foundation, Dallas, Texas, of which Dr. E. H. Cary is president, has been started. A fund of a million dollars is now held by the Foundation for the building of the main plant of the Southwestern Medical College, which will be constructed adjacent to the new $7,000,000 City-County Hospital, as the nucleus of a Medical Center.

Returning veterans and displaced war workers who are scientifically and professionally qualified and who are seeking employment in industry, nonprofit research institutions, colleges, and universities are offered the help and the extensive resources of the National Roster of Scientific and Specialized Personnel. Many veterans plan to return to their former employers and need no help. Many industries can shift their technical staffs from war to peace production. On the other hand, a number of plants are not able to absorb the staffs formerly engaged in war production in their peacetime operations. All this adds up to a large amount of change and readjustment. Numerous statements have been made, apparently on good authority, that there are personnel shortages in most of the professions. It remains for an agency such as the National Roster, operating on a nation-wide basis, to assist all other efforts on the part of professional societies and individuals to find employment for all those who are rapidly becoming available.

Separation centers of the Armed Forces are cooperating with the National Roster to assist professionally qualified veterans to find employment in civil life. Return postcards and application and registration blanks are provided, and each center will be supplied at least every two weeks with a current list of positions that are open. The placement section of the National Roster will send brief statements regarding applicants to employers who have placed job orders with the Roster. In order to save time and increase chances of placement, these summaries are sent at the same time to several different employers having identical requirements.

Technical and professional personnel leaving war industries are invited to notify the National Roster that they are available for employment. If any are not already registered with the Roster, registration blanks will be sent to them promptly on request.

All employers who are not able to retain their full staffs and who wish to assist those of their professional employees who are leaving are asked to advise these individuals to ask aid of the Roster. Employers who are in need of additional personnel should send to the Roster descriptions of the positions which they wish to fill, together with detailed requirements as to age, extent of education, and amount and nature of experience.

Professional and technical societies that are engaged in organized efforts to place members of their professions are privileged to ask the cooperation of the National Roster.

The Roster is prepared to undertake placement in practically all professional fields except in elementary and high-school teaching, and does not restrict its help to the fields in which it maintains its registry.

The address is: National Roster of Scientific and Specialized Personnel, 1006 U Street, N.W., Washington 25, D. C.

Columbia University has filed plans with the Department of Housing and Buildings for an $800,000 auditorium and library at 646–54 West 168th Street at Fort Washington Avenue. The plans call for a ten-story structure, with an auditorium on the first floor and a library and reading rooms on other floors. The proposed library and auditorium would serve the College of Physicians and Surgeons at the Columbia-Presbyterian Medical Center. A campaign to obtain funds is planned.

The National Geographic Society, Washington, D. C., has announced plans for a series of flights between Washington and the equator to study cosmic rays. It is reported that the Army will cooperate with the society and that B-29's probably will be used. The flights will be made at different altitudes ranging from 5,000 to 35,000 feet, next spring.

A collection of 55 human embryos and fetuses, stained and cleared by the Scrultze technique, has been donated by Dr. Samuel Rabkin of Cincinnati to the Division of Physical Anthropology of the U. S. National Museum. When the specimens from this collection are viewed against a light they appear semitransparent, except for the skeletons, which are stained red and which vary in their completeness according to the developmental stages reached (6 weeks to 6 months). Accordingly, this collection lends itself both to exhibition and to study purposes and thus supplements the vast numbers of dried skeletons from late fetal and postnatal stages assembled in the Division by the late Dr. Aleš Hrdlička. In placing this material in a national institution it is Dr. Rabkin's desire that it be utilized by interested students. He prepared the material, which was collected on the white ward of a Cincinnati hospital, in connection with his studies on the development of the jaws. However, the material lends itself also to studies on other parts of the skeleton and to investigations in related fields.

Maj. Gen. Leslie R. Groves, director of the Manhattan District—code name for the Atomic Bomb Project—will address the joint meeting of the Institute of Radio Engineers and the American Institute of Electrical Engineers in the Engineering Society's Auditorium in New York, Wednesday evening, 23 January 1946. Gen. Groves will speak on "Some Electrical, Engineering, and General Aspects of the Atomic Bomb Project." Dr. Austin Bailey is in charge of the arrangements. Joint meetings between the IRE and the AIEE have been held since 1943 during the period in which the IRE holds its annual Winter Technical Meeting and the AIEE holds its Winter Convention. The Institute of Radio Engineers will be host at the joint meeting this year. At this joint meeting also, it was announced by Dr. Scott

Turner, chairman of the Hoover Medal Board of Awards, that the Hoover Medal, established in 1930 as an award by engineers to a fellow engineer "for distinguished public service," will be presented by the AIEE, the recipient to be announced later. This will be the seventh Hoover Medal awarded since 1930.

Rinehart and Company, Inc., is the new name of the book-publishing firm formerly known as Farrar and Rinehart, Inc. The address remains the same, 232 Madison Avenue, New York City.

Forty-five research chemists of Princeton University who worked on the atomic bomb project were awarded lapel pins in a ceremony on 26 December 1945. The group has been working under the direction of Hugh S. Taylor, chairman of the Department of Chemistry, and Prof. N. Howell Furman, analytical chemist.

The American Chemical Society will award fellowships aggregating $210,000 in 1946 and 1947 to aid in the training of chemists and chemical engineers, it has been announced by Bradley Dewey, president of the Society. Predoctoral students whose work was interrupted by the war will receive $100,000. Grants of $110,000 will be made to holders of the doctor's degree who desire to devote one or two years to research and teaching. Funds for the program have been allotted from a $500,000 educational fund established by the Society last April "for the advancement of chemistry" through assistance to promising young men and women, "the better to enable them as leaders to add distinction to the chemical profession and to ensure our country's welfare."

The predoctoral fellowships will carry an annual stipend of $1,200 for single candidates and $1,800 for married candidates, plus a maximum of $500 a year for tuition and laboratory charges. In the selection of recipients, great weight will be given to each applicant's sacrifices and contributions to the war effort, with special consideration for those who had begun their graduate work before they entered war service. "The granting of these predoctoral fellowships in chemistry and chemical engineering by the American Chemical Society is an immediate postwar measure," it was explained. "While successful candidates may reasonably expect continuation of support until their postgraduate work is completed (for a maximum period of three years), continued aid will be contingent upon satisfactory progress by the fellow."

These fellowships will be granted on the same scale as those of the National Research Council, and the committee reviewing applications for Council fellowships has been designated as the American Chemical Society Predoctoral Fellowship Committee. Members of the committee are: Prof. T. R. Hogness, of the University of Chicago, chairman; Prof. J. C. Bailar, Jr., of the University of Illinois; Prof. O. A. Hougan, of the University of Wisconsin; Prof. L. I. Smith, of the University of Minnesota; and Prof. H. H. Willard, of the University of Michigan.

Application blanks may be obtained from Prof. Hogness or from the American Chemical Society, 1155-16th Street, N. W., Washington 6, D. C. All applications should be sent to Prof. Hogness at the University of Chicago before 1 April 1946.

Postdoctoral fellowships will carry a stipend of $2,500 a year, with the understanding that the institutions at which the recipients study will provide an additional sum, presumably at least $1,000 a year, for teaching. Awards will be for one year, and will be renewable for a second year upon proof of satisfactory performance. Chemists and chemical engineers who received the doctor's degree since 1 January 1940 and have been engaged in war work, or persons who will have obtained the doctorate during the twelve-month period prior to 1 November of the year in which the award is made, are eligible for postdoctoral fellowships. All standard branches of chemistry and chemical engineering, including biochemistry, are covered by the grants, some preference being given to candidates interested in pure research. The Society plans to award ten of these fellowships before 1 June 1946 and ten more between that date and 1 March 1947.

Dr. W. Albert Noyes, Jr., head of the Chemistry Department at the University of Rochester and president-elect of the Society, heads the committee which will administer the postdoctoral fellowships. Others on the committee are Dr. Edwin R. Gilliland, of Massachusetts Institute of Technology, and Dr. Ralph L. Shriner, of Indiana University.

Applications for the postdoctoral fellowships, which should be sent to Dr. Noyes at the University of Rochester, must be submitted prior to 1 April 1946 by those who intend to begin work before 1 January 1947, and prior to 1 February 1947 by those who intend to begin work by 1 November 1947. Application blanks may be obtained from Dr. Noyes or from the Society's headquarters in Washington.

The Sun Oil Company and the *Houdry Process Corporation* announced plans for construction of two plants to produce carbon 13 in comparatively substantial quantities. In biological research, carbon 13 is used as a tracer. Indistinguishable chemically from ordinary carbon the isotope, carbon 13 is absorbed in living tissue and undergoes the same metabolic process as does ordinary carbon. But where ordinary carbon cannot be traced as it passes through the intricate metabolic reactions carbon 13 can be detected by the use of the mass-spectrometer, and identified with specific bodily functions.

The Houdry Process Corporation has had in operation a thermal diffusion plant for the concentration of carbon 13, producing about one-fourth of a gram per month. This material has been made available *without cost to members of the Isotope Research Committee* for distribution to biochemical research institutions. Carbon 13, produced by the two new plants which Sun Oil Company will build, "will be made available without cost to qualified, non-commercial biological and medical research organizations whose activities and experience justify such donations." The carbon isotope now produced by the Houdry plant costs in the neighborhood of $400 a gram.

One of the new plants will duplicate the existing thermal diffusion plant and will be built for Sun Oil Company at the Houdry laboratories.

The other new plant will be constructed at Sun Oil Company's Marcus Hook Refinery and will be considerably larger in size. The complete plant will represent an investment of approximately $100,000 and, when operated at maximum capacity, will produce heavy carbon at the rate of about 500 grams per month. It is hoped that with this larger plant the cost of carbon 13 can be brought down to the order of $40 per gram. The construction of both thermal diffusion plants is based on a design by Dr. Alfred O. Nier, of the Department of Physics, University of Minnesota.

The Iowa State College Statistical Laboratory, under the direction of George W. Snedecor, will complete a study of a nationwide sample of population early this year. An additional grant of $35,000 to the Industrial Science Research Institute has been made for the work. The population sample, which will make possible the taking of a census more often than every 10 years, is an outgrowth of work by the laboratory on the Master Sample of Agriculture. The agricultural sample was completed in November 1944 and was used in the agricultural census this year. When data are tabulated, the sample figures will be checked against the complete enumeration. This sample covered 67,000 areas and approximately 300,000 farms. The planned population sample will include large cities and towns and will cover 200,000 areas and approximately 1,200,000 households. The work on the new sample has been done cooperatively with the Bureau of Agricultural Economics of the U. S. Department of Agriculture and the Bureau of the Census of the U. S. Department of Commerce. When completed it will mean a great saving in labor and expense in gathering census data.

The American Association of Scientific Workers, through its Committee for International Relations, Bart J. Bok, of Harvard, Chairman, released a nine-point plan to the press dated 30 December 1945. The plan outlines specific techniques designed to make the United Nations Educational, Scientific and Cultural Organization (UNESCO) in large measure responsible for the future welfare of science. The Committee asks that scientists everywhere discuss these proposals and suggest deletions, modifications, and improvements in them. The proposals follow:

1. UNESCO should promote the exchange of scientists, young and old, on a world-wide basis.
2. UNESCO should be charged with the responsibility of facilitating in every way the prompt interchange of scientific information.
3. UNESCO should take the leadership in the reorganization of scientific abstracting since many of the pre-war media were traditionally in German hands.
4. UNESCO should be an active agency to promote congresses of scientists of all nations. It should facilitate the prompt revival of the pre-war international scientific unions and assist in the formation of new unions.
5. UNESCO should aid making money available for the rehabilitation of scientific institutions in areas devastated by the war.
6. UNESCO should give aid and advice to the growing scientific institutions in countries like China, India and some of the Latin American Republics, particularly in providing much needed guidance in agricultural and technical matters.
7. UNESCO should undertake comprehensive surveys of the scientific and technological potentialities and resources of underdeveloped regions and should issue full public reports of the results of these surveys.
8. UNESCO should coordinate its activities with those of other international organizations with scientific and technological functions. There should be a close liaison between the science division of UNESCO and international organizations which are concerned with public health, communications, food, agriculture and fisheries, mineral resources, standards and power.
9. UNESCO should become the principal scientific advisory body in the United Nations Organization.

Meetings

A Conference on Industrial and Chemical Infrared Spectroscopy will be held at Mendenhall Laboratory of Physics, Ohio State University, Columbus, Ohio, on 13, 14, and 15 June 1946. This meeting will be sponsored jointly by the Physics Departments of the University of Michigan and the Ohio State University. The Conference will be a part of a larger symposium on Molecular Spectroscopy and Molecular Structure, to be held at the Ohio State University beginning

Monday, 10 June, and extending to 15 June. More complete details on this symposium will be published in a later issue of *Science.* Inquiries concerning the Infrared Conference may be directed to Dr. Harald H. Nielsen, Mendenhall Laboratory, or to Dr. Norman Wright, Dow Chemical Company, Midland, Michigan.

The New Orleans Academy of Science, under the leadership of Dr. L. J. Pessin, president, is celebrating its ninety-third year of service. All meetings are held at the Howard-Tilton Library, Tulane University. The program for the balance of the year includes: "Postwar Problems in Tropical Medicine," by Dr. Ernest C. Faust, Tulane University, on 21 February; "Hurricanes," by Mr. W. R. Stevens, U. S. Weather Bureau, on 21 March; and the Annual Meeting, the dates and program of which are to be announced.

Conditions Abroad

The Kaiser Wilhelm Institutes in Dahlem are intact and are being used by the American Army, according to information received by Prof. Richard B. Goldschmidt, of the University of California, Berkeley. The contents and staff of some (not specified) are said to have been removed to Russia. Although no details are available, it is reported that Timofeeff's Institute in Buch is one of these. In Würzburg, Burgeff's Botanical Institute and Just's Genetical Institute have been completely destroyed, Schleip's Zoological Institute (Boveri's old institute) has been mostly destroyed, and Elze's Anatomical Institute, partly destroyed. Fischer's Chemical Institute is intact.

Dr. W. Adam, of the Musée Royal d'Histoire Naturelle de Belgique, Brussels, has written to Dr. S. Stillman Berry, Redlands, California, that he has now returned to Brussels after a short evacuation period in France. While in Paris, Dr. Adam worked for about four weeks in the laboratory of R. Dollfus in the "Museum," where he made a revision of the Sepiidae of de Rochebrune. He adds that after the first year of occupation his work on Cephalopoda had to be abandoned and that recently he has worked exclusively on the Belgian Mollusk fauna. Gradually, Belgian scholars are resuming their research and writing activities and are now receiving American and English books. In conclusion, Dr. Adam reports the death in May 1945 of Paul Pelseneer, Belgian zoologist and teacher of chemistry.

Nature reports that after evacuation for a period of three years to Saratov, the Leningrad Society of Naturalists has resumed its activities at the State University of Leningrad. Several meetings, general and sectional (zoology, botany, physiology, and geology), were held last spring, and publication of the *Travaux* has also been started.

Recent Deaths

Dr. Hans Fried, 52, died suddenly at his home in Lansdowne, Pennsylvania, on 23 December 1945. Dr. Fried arrived in the United States from Austria in 1940. From September 1941 until November 1943 he was assistant in the Sproul Observatory, taking part in the measuring, reducing and discussion of photographic plates, and since July 1944 he had been lecturer in mathematics at Swarthmore College.

Dr. Edward Frankland Armstrong, 67, chemical consultant, adviser to the Ministry of Home Security and a member of the Civil Defense Research Committee, died in London 15 December 1945.

Dr. Arthur M. Banta, 68, professor emeritus of biology at Brown University, died on 2 January 1946.

George F. Eckhard, 67, dean of the University of Vermont's College of Engineering since 1932 and a member of the engineering faculty since 1915, died on 28 December 1945.

Benjamin H. Walden, 66, assistant entomologist at the Connecticut Agricultural Experiment Station, died on 6 January 1946.

Dr. Thomas Barbour, 71, a member of the faculty of Peabody Museum, Harvard University, and custodian of the Harvard Biological Station at Soledad, Cuba, died 8 January 1946.

Maj. Allan Brooks, 76, illustrator of bird books, died on 3 January 1946 at Courtenay, B. C.

Dr. Max H. Poser, 75, technical representative of the Bausch & Lomb Optical Company, died in Rochester, New York, on 4 January 1946.

Harry Taub, 46, professor of pharmacology at Columbia University and president of the New York Association of Clinical and X-ray Laboratories, Inc., died on 19 December 1945.

Dr. Louis Cleveland Jones, 75, industrial chemist, died on 29 December 1945 at Greenwich, Connecticut.

Ward Curtiss Priest, head of the Department of Physics and a member of the faculty of St. Lawrence University for thirty-four years, died on 20 December 1945.

Dr. Arthur Korn, 75, who was said to have been the first to transmit a photograph over wires, and is credited with founding the present system of phototelegraphy, facsimile, and radiophoto, died on 21 December 1945 at Jersey City.

Dr. Hale Houston, 74, professor emeritus of engineering at Washington and Lee University, died in Lexington, Kentucky, on 27 December 1945.

Letters to the Editor

Reply to Professor Reed

Many of us at the Naval Ordnance Laboratory have read with much interest the letter from Professor H. S. Reed to Senator Downey (*Science*, 1945, 102, 524) which was unanimously approved by certain of our colleagues of the American Association for the Advancement of Science. The letter seems to portray a lack of understanding of the problems confronting some of us in the employ of the Government and, I am sorry to say, is not likely to be very helpful in our attempts at their solution.

Those of us who have had considerable experience in research in Government are well aware of the difficulties encountered, yet we have seen programs carried out effectively and economically in spite of them. We are making strenuous efforts to obviate these difficulties and to raise the prestige of governmental scientific establishments. It is unlikely that we will be successful unless we have the approval and support of other scientists in the country. Therefore, a letter such as Professor Reed's assumes to us a very considerable importance.

Unless the United States assumes a more positive, constructive, and powerful position in world affairs from a political point of view, it is unlikely that we shall be successful in maintaining world peace. Whether our attempts to maintain peace are implemented by strong and wise political action or whether we take our chances with partial isolation as we have in the past, it is likely that a strong Navy will be necessary. There are a few hundred of us working in naval laboratories who have a very direct responsibility, in view of the present state of military technology, to keep the Navy strong. The naval laboratory programs make it necessary for us to carry on basic research in certain parts of certain fields simply because no other agency is interested in, or has the facilities for, doing this work. We, of course, carry on a very great amount of development also, again because neither academic nor industrial establishments are interested in doing, or are equipped to perform, this particular type of development.

We have observed with great interest the course of the Magnuson and Kilgore bills and the testimony which has been given in the hearings on them. We have a keen appreciation for the need of Federal support of research in this country and realize that this implies new sources of support for institutions which rely on the diminishing returns from endowments to maintain their high standards of productivity. The Bureau of Ordnance plans to spend about one-fourth of its research budget in such support by means of very general research projects assigned to universities. We are glad to see these things being done and give our wholehearted support to Congressional action in this direction.

However, *unless and until the great body of American science gives concrete evidence of its willingness to mix into naval affairs, to do the work which the Navy needs in the way of basic and applied research,* and *to prove that it will take continued interest in so supporting the Navy,* these naval laboratories must carry the responsibilities which they now bear.

We have instigated machinery for bringing about the changes necessary to make naval and all governmental laboratories more attractive places for scientists to work. We have fortunately received enthusiastic support for our efforts from a substantial number of very prominent and competent scientists, and we are inclined to doubt that Professor Reed's letter really expresses the sentiment in the rank and file of scientists in the United States toward the amount of consideration which we merit or the importance of the responsibilities which we carry.

R. D. Bennett, Captain, USNR

Naval Ordnance Laboratory
Washington, D. C.

Subaqueous Mud Cracks Formed by Settling

Mud cracks in strata have been accepted as a criterion that the sediments in which they were formed had been exposed to air. A recent observation on the part of the writers indicates, however, that this conclusion is not always a safe one.

In the process of making a ditch by means of dynamite, a pool of considerable extent was left filled with water for a period of about a month. The clay forming the bottom was originally smooth, but after three weeks developed a mud-crack pattern under water which could not be distinguished from sun-crack patterns formed subaerially. The dynamite blast served to loosen the soil to a considerable depth. In fact, the material at the very surface had been raised into the air by the explosion and had fallen back. However, in so far as direct observation could indicate, such material formed only a thin, negligible surface layer and probably had little, if anything, to do with the crack pattern which ultimately developed. The soil consisted mainly of fine clay material. That at the surface compacted, forming a relatively rigid bottom. Subsequently the deeper soil settled, the surface layer yielding to the movement by developing a typical polygonal mud-cracking pattern.

This observation suggests a need for caution in the interpretation of mud cracks in the geological record as evidence of exposure to air. Earthquakes produce a shock which tends to loosen soil. That settling following earthquakes may produce such patterns subaerially in soil has not escaped observation. Fossil mud cracks should be examined more closely in order to determine whether they are a true record of emergence or whether they may conceivably be a record of disturbances, particularly when they are found in sediments deposited at the time of some of our major orogenies. The Paleozoic mud cracks which have come to the attention of the senior author differ from those formed by settling, in that they are relatively shallow, rarely over two inches in depth, relatively wide, and are terminated abruptly beneath by a bedding plane.

Such shallow structures represent drying of an unconsolidated top layer deposited upon a layer sufficiently older and more consolidated not to be affected similarly, and may safely be interpreted as sun cracks. The observed cracks, formed by subaqueous settling, could be traced downward to a depth of eight inches and probably extended farther. Extensive drying of unconsolidated materials, as under pleya conditions, may produce cracks of similar surface appearance and depth. No certain criterion seems available to determine whether such markings actually represent sun cracks, or whether they may represent settling cracks which may or may not have been formed subaqueously.

Rousseau H. Flower and Willard G. Ives
New York State Museum

Soviet Biology

The article on Soviet Biology by Dr. Anton Zhebrak (*Science*, 1945, 102, 357–358) is of great interest. He assures us that the official policy of the Soviet Government toward Genetics is tolerant and even helpful, and always has been. If this is so, it is strange that Russian geneticists were absent from the Sixth International Congress of Genetics held in Edinburgh before the outbreak of the war and from the recent London Conference on Genetics, at which Belgium, Denmark, France, Holland, Norway, Sweden, and the United States were represented. Russian geneticists had also been invited to both conferences at the same time as the others. It would do more to dispell the "misunderstanding" imputed by Zhebrak to geneticists of the Western World if we were told why Russian geneticists do not participate in international conferences. Above all, it would remove our anxiety if we were told what happened to Dr. N. I. Vavilov and to his work after 1939, since this work is regarded as being one of the most important contributions of Soviet Russia to the science of the world.

P. C. Koller
Royal Cancer Hospital, London

Study of Scientific Russian in American Universities

The importance of American scientists closely following the published Russian researches in their fields is gaining general recognition in this country. In this connection the American Association of Teachers of Slavonic and East European Languages, about a year ago, appointed a Committee on Teaching Scientific Russian.

A preliminary inquiry was conducted among universities where scientific Russian was known to be taught. It must be emphasized that practically everywhere in the 81 American institutions of higher learning where Russian was taught in the school year 1944–1945 (A. P. Coleman, *Amer. Slav. East Eur. Rev.*, 1945, 4, 185–208) scientists or students of science were enrolled in Russian classes. Furthermore, a number of industrial organizations in this country now have classes in Russian organized for their technical employees. The figures given below, based on replies from 25 universities, must, therefore, be considered as smaller than the actual numbers. The principal objective of publishing this note consists in calling to the attention of American scientists, language teachers, and all interested individuals the need of introducing Russian wherever scientific and engineering training is given.

Of the institutions covered by this inquiry, 21 now accept or recommend Russian in partial fulfillment of the language requirements for graduate degrees in science. In other universities, acceptance, although not decided upon, is probable. About four hundred students were studying scientific Russian during the 1944–1945 school year. The figures for the current year are too incomplete for use. Chemists studied Russian in larger numbers than did other scientists; biologists, including physicians and medical students, came next and were followed by physicists, including radio engineers.

Organization of special courses in Russian for scientists, apart from courses in general Russian, wider acceptance by American universities of Russian for graduate degrees in science, and procurement of Russian technical books and magazines are urged by this Committee.

J. G. Tolpin
Universal Oil Products Company, Chicago

A Correction

Please correct a detail on page 17 of your issue of 4 January. You describe and quote from certain resolutions passed by the Metropolitan Section of the American Physical Society on 9 November; and in the course of your description, you unluckily speak of the position of the "Society" rather than that of the Section. Now, the fact is that fewer than five per cent of the members of the Society were present at that meeting, of which no one had been notified in advance except the members living in and near New York and a few others. The resolutions cannot therefore be taken as an expression of the Society, even though many—myself included—think that a majority of the Society agree with them.

Karl K. Darrow, *Secretary*
The American Physical Society

Scanning Science—

Hon. A. D. White, formerly President of Cornell University, appeared on February 10th before the Senate Committee on a National University. He argued in favor of the plan, saying that in this respect the United States government is behind the European states. He contended that instead of weakening other universities, as had been claimed, the establishment of a National institution would strengthen all other seats of learning. It is expected that the committee will report favorably.

—21 February 1896

Book Reviews

***Fungicides and their action.* James G. Horsfall. Waltham, Mass.: Chronica Botanica, 1945. Pp. 239. Illustrated. $5.00.**

This book, by a leading authority on fungicides, is the first in English exclusively on this important subject. It is especially welcome to plant pathologists for whom the principal treatises on fungicides have been in books devoted mainly to insecticides, with fungicides treated as a secondary, but related, subject. Horsfall has devoted most of the past fifteen years to intensive research on fungicides, and he and his associates at Geneva, New York, and at New Haven, Connecticut, have contributed many of the noteworthy advances in the knowledge of fungicides during that period. The present volume, as the writer states, " . . . . is no cook book. It provides no recipe for cooking railroad ties in creosote, no spray schedule for combating apple scab or potato blight. It attempts to develop the underlying theory on which the practice is based, and by which the practice may be improved." In this he has signally succeeded. This book would constitute a fine textbook on the subject and an excellent handbook for professional plant pathologists, but would be of less value to extension men or growers.

Some of the important subdivisions of the subject matter are: history, general concepts (including definitions), laboratory assay, data assessment, principles of chemical protection, deposition, coverage, tenacity, artificial immunization and chemotherapy, action of specific fungicidal chemicals, antagonism and synergism, and phytotoxicity. There is a bibliography of 502 titles, a subject index, and an author index. The treatment is up to date. Some topics, such as chemotherapy and organic nitrogen fungicides, refer mostly to work in the past ten years, and much of the information on toxicity of organic compounds consists of previously unpublished data of the writer and associates. The various basic methods by which a parasitic organism may be rendered innocuous by chemicals are described and classified with examples. The treatment of bio-assay by means of straight-line dosage response curves is one of several unique features of the book. In addition to reviewing data previously presented in this way the writer has recalculated data in the literature in order to present it in this illuminating manner. There is an excellent treatment of toxicity and its relation to the molecular structure of organic compounds. The structural formulae of the more important members of several groups of fungicidally interesting compounds is given. Statistical methods and chemical analytical methods are largely omitted.

The documentation is quite thorough, but errors and omissions have crept in. On page 16 Horsfall refers to Neuberg's bio-assay of soil fertility, when he likely meant Newbauer, and no reference is given. On page 91 he refers to Wilson's data on coarse Bordeaux deposits, but the reference is to a paper which does not contain this information, and the correct reference is not included in the bibliography.

The manner of writing is more successfully designed for reader interest than is most scientific writing. Some will wonder, however, if "dunking" of spores is superior to dipping, and what the writer means by "smoked out the dithiocarbamates."

To treat the subject of fungicides in 188 pages of text necessitates the omission of much pertinent material, and it is to be expected that the balance chosen would be subject to criticism. Some of the more vulnerable aspects may be pointed out. Most of the specific data on foliage fungicides refers to tests on glass slides, and this is the only technique given in detail. The matter of tests on leaves is treated in fourteen lines and dismissed with the remark: "No evidence has been adduced yet that this procedure is more precise or reproducible or indicative than modern methods using the much simpler equipment for spore germination." Data in some of the papers listed in the bibliography as well as in others not listed indicate that this is not the case. And how do tests on slides require simpler equipment than tests on leaves? Not all will agree with the author's apparent attitude (previously published) that organic fungicides will soon replace the inorganics, and that " . . . . Bordeaux mixture and elemental sulfurs will be turned out on pasture to spend their last years in leisure as a reward for a good job well done." In the history of fungicides, credit for introducing copper carbonate for wheat bunt is given to Darnell-Smith (1917), and Von Tubeuf's recorded success with this remedy in 1902 is not mentioned. Nevertheless, this book may itself be a landmark in the history of fungicides.

C. E. YARWOOD

University of California, Berkeley

***L'hérédité et l'homme.* Jacques Rousseau. Montreal: Les Editions de L'Arbre, 1945. Pp. 250.**

The author has prepared a brief résumé of the physical basis and methods of inheritance and catalogued into appropriate divisions many human hereditary characteristics. The genetic bases of most of these traits are discussed only briefly, and some of them are reported to have a simpler type of inheritance than facts justify. The author has a manner of expression which engages the reader's attention. Original sources of data are not usually given.

Except for an occasional gem of humor, nothing unusual is found in the chapters dealing with the elements of heredity. Diagrammatic figures used to explain genetic crosses are well done and helpful to a reader. A chapter on sex determination includes folk tales about sex control. It is unfortunate, however, that with his references to the use of a douche by Unterberger, by investigators using experimental animals to get a preponderance of one sex, and in the ultimate production by that means of a male heir to Hirohito, the author did not refer to the less favorable results obtained by other workers.

In several chapters, the author names and briefly discusses many human hereditary anomalies and nonabnormal traits. These include body-build and anatomical characteristics and defects, blood diseases, metabolic defects, nervous and mental disorders, diatheses, and talent and character. Baldness is explained as a sex-influenced trait due to a one-gene difference, but the author's use of different symbols for males and females may be disturbing to the general reader. The inheritance of the blood groups and types and their use in determining parentage are explained rather completely. The author refers to and explains the three theories of inheritance of the AB groups—that is, as multiple alleles, two pairs of genes with independent assortment, and two pairs of linked genes.

In a concluding chapter on eugenics the author discusses the erroneous belief that eugenics and sterilization are synonymous, the blame being placed upon the mock modesty of the Anglo-Saxons. He cites the many methods which have been followed or suggested in the practice of negative and positive eugenics. The author specifies those methods which some persons cannot accept because of religious or other beliefs and mentions others, such as premarital examinations and studies of family histories with suggested celibacy or continence, which might be followed. The use of genetic analysis to help guide a person into proper marriage is a method of eugenics which should be emphasized more.

C. P. OLIVER

University of Minnesota

Vertebrate paleontology. (2nd Ed.) Alfred Sherwood Romer. Chicago: Univ. Chicago Press, 1945. Pp. ix + 687. (Illustrated.) $7.50.

The publication of the second edition of *Vertebrate paleontology* will be universally welcomed by students of vertebrate evolution and especially by those of the English-speaking countries. The first edition of this excellent textbook filled a long-felt need and established for itself a solid reputation during the twelve years that have elapsed since its first appearance. It can be confidently expected that the new edition will continue the good record of this book.

The new edition is larger than the first edition, there being 687 pages in this book as compared with 491 pages in the earlier one. This increase is the result, in part, of new discoveries and new research in paleontology and, in part, of the inclusion of three new chapters on the history of the vertebrates—an innovation that will add appreciably to the value of the volume. These additions of subject matter naturally have resulted in a considerable amount of rearrangement in the text, so that in numerous places the new edition is quite different from the earlier book. Moreover, those portions of the earlier text that have been affected by new discoveries and new research have been accordingly rewritten and modified.

Needless to say, changes in details are numerous and only a few of the most outstanding points can be mentioned here. For instance, there is a new chapter on the placoderm fishes, and one each on the synaptosaurian and lepidosaurian reptiles. The Placodermi are made an inclusive group, containing the acanthodian fishes. The presentation of the teleosts has been expanded to emphasize their position as the dominant fishes of post-Cretaceous times. The Seymouriamorpha are considered as amphibians rather than as stem reptiles, following evidence brought forward in recent years by Russian authorities, while the mesosaurs are discussed along with the synapsid reptiles. Finally, the most mammal-like of the reptiles are treated as a separate order, the Ictidosauria.

Among the mammals, the Dermoptera are reduced to a suborder of the insectivores, while the miacids are placed in the fissipede carnivores, rather than in the creodonts as formerly. An interesting difference between the new edition and the old one is the placing of the primates immediately following the insectivores, the position of their natural relationships, rather than at the end of the book as the "culmination" of vertebrate evolution. In this regard it might be remarked that the tree shrews are considered as primitive primates rather than as insectivores—a reflection of the trend of opinion among modern mammalogists. The discussions of the Cenozoic mammals of South America have been amplified and revised in accord with the work done in recent years by certain North American students of these animals. Studies on the ungulates by various authorities in recent years have resulted in a revision of the treatment of these mammals in the text, while the lagomorphs are now made a separate order of mammals, as is generally recognized by modern mammalogists.

These changes and many more have been made with a thoroughness and a balance of judgment characteristic of Dr. Romer's very comprehensive knowledge of the vertebrates. Many new figures have been added to accompany the changes and expansion in the text. Of particular importance are the phylogenies, all of which have been revised and redrawn for the new edition. Even with the added new figures and the revised phylogenies, however, the bulk of the illustrations have been taken over from the earlier edition.

The classification at the end of the book is greatly expanded and changed (some of the changes have been indicated in the foregoing discussion) to include practically all genera of vertebrates occurring as fossils. This section of the book will prove to be extraordinarily useful to students working in fields of vertebrate studies.

The book is brought out in a new format conformable with other textbooks of the University of Chicago Series. This is particularly apparent in the new typeface and the cover. It is unfortunate, with an attractive and modern format, that wartime conditions resulted in the printing of this book on an inferior grade of paper. Because of this, the effectiveness of some of the figures is reduced, and the bad results of these economics are especially apparent in the index, which is rather difficult to read. Also, the price of the book is unfortunately high, and this may discourage some people, especially students, who have a real need for it from buying it. But these are minor criticisms which can in no way be leveled at the author. All in all, this book is a masterpiece of thorough and comprehensive scholarship that every student of vertebrate evolution will want to own.

EDWIN H. COLBERT
American Museum of Natural History

Textbook of bacteriology. (14th ed., rev.) Edwin O. Jordan and William Burrows. Philadelphia: W. B. Saunders, 1945. Pp. xvii + 909. (Illustrated.) $7.00.

In preparing the fourteenth edition of this textbook the author continued the process of rewriting begun in the preceding edition and has achieved a considerable degree of transformation of the book into a text for medical students, both by the general emphasis on medical phases of the subject throughout and, more specifically, by introducing the discussion of the methods of bacteriological diagnosis, so conspicuously absent in the preceding editions. The omission from the previous edition of such important topics as antibiotics or iso-antibodies has been corrected, although in the presentation of the latter subject the significance of the important antigenic components of human erythrocytes other than the three major type-antigens is not discussed.

The organization of the material has been greatly improved in many instances through the adoption of a more logical sequence. Thus, for instance, the cholera vibrio is now discussed in connection with enteric organisms instead of having been placed with spirochetes. However, this process of organization was not followed in Chapter 26 or in the instance of venereal diseases, where gonorrhea is discussed on page 350, chancroid on page 473, syphilis on page 681, lymphogranuloma on page 823, and granuloma is mentioned only in the footnote on page 824.

Considering the limited space available, the new chapters covering the subject of medical mycology and medical parasitology, respectively, are excellent. Descriptions of organisms are clear and concise, yet they include most of the recent material in these fields.

The format of the book is commendable, the index is good, and the illustrations are unusually well reproduced.

J. J. BRONFENBRENNER
School of Medicine
Washington University, St. Louis

Russian-English scientific-technical dictionary. A. Bray. (Ed.) New York: International Universities Press, 1945. Pp. xvi + 551.

The publication of this dictionary fills an urgent need of readers and translators of Russian scientific and technical material. Despite increasing interest in Russian scientific literature in recent years, access to it has been impeded by the absence of a general Russian-English technical dictionary. The Russian-speaking reader of English material has been very fortunate in having a plentiful supply of dictionaries to meet his needs. The English-speaking reader, however, has had to guess the possible meaning of a word from the context and then check his guess against English-Russian technical dictionaries. Bray's new dictionary is a belated acknowledgment of the importance of scientific and technical work in the USSR, even though it ignores the critical fields of medicine and biology.

The present volume, containing 20,000–25,000 terms, is not as complete as the companion *English-Russian technical dictionary*, a 60,000–65,000-term volume released by the same publisher in 1941. This may be explained in part by the fact that the Russian technical vocabulary does not contain as many synonyms as does the English. However, some of the Russian terms which appear as equivalents of English terms in the older volume do not appear in the Russian-English work. The present volume does have a complete bibliography of sources and references, a matter which was omitted in the previous work.

The reviewer made a random selection of fifty Russian radio and engineering terms and of twenty-five Russian textile terms from a list of terms which had caused him difficulty in the past year. Almost all of the radio and engineering terms were found in this book. About half of the textile terms were found, although they were unusual and not particularly important. In general, the coverage of terms of the physical sciences and technology is sufficiently complete to meet all reasonable needs and sufficiently up to date to include "bazooka" and "radar."

RAYMOND A. BAUER, Ensign, USNR
Washington, D. C.

Coasts, waves and weather for navigators. John Q. Stewart. Boston: Ginn, 1945. Pp. vii + 348. (Illustrated.) $3.75.

Stewart's book is divided into three parts: "Coast lines, terrain and routes"; "Oceanography for navigators"; and "Meteorology for navigators." The first part should be of particular value to air and sea navigators and to the interested traveler. A general classification and description of coast lines is followed by chapters containing numerous quotations from the "Pilots" and the "Sailing directions" published by the Hydrographic Office. These chapters are profusely illustrated by aerial and ground photographs which clarify the features emphasized by the author. The reader ought to have a fairly good knowledge of general geography in order fully to enjoy the descriptions, because the examples are selected from all parts of the world and the author takes the reader from Peru to the coast of Maine and back to Patagonia without stopping for breath. The plan followed serves, however, to bring out the similarities in the character of coast lines within widely separated regions.

The part on oceanography represents a welcome addition to popular scientific literature, because few texts contain much information about the character of the ocean waters, the tides, and the ocean currents. The chapters on tides should be particularly helpful to the navigator who wants more information as to the contents of tide tables and the character of the tides. The section on ocean waves will need some modification when the results of studies conducted during the war become available. Photographs of heavy seas, of wave patterns, and of ice in the sea are particularly striking.

The part dealing with meteorology is well arranged in a manner which guides the reader from the simpler to the more complicated concepts. The progress made in the understanding of the physics of the atmosphere is brought out clearly, and the need for much more information is repeatedly stressed. Disturbed by the fact that the mysticism of the atomic physics appears to appeal strongly to people, the author pleads that "we can not afford to let the coming peace bring again such a retreat from the reality of earth, sea, air and the human mass."

A few details must be criticized. In the section on ocean waves, the statement that "breakers can occur in water much deeper than a wave-length, although a depth of about half a wave-length is more usual," is in error, because the depth of breaking depends principally upon the height of the breaker and not upon the wave length. Also, the author contradicts himself implicitly on the following page.

The chart of the ocean currents of the world gives the erroneous impression that the entire current which flows through Drake Passage continues along the coast of southwest Africa, whereas actually by far the greater mass of water is part of the Antarctic Circumpolar Current. There are also other details in this chart which are in error. An equally simple presentation could have shown the features correctly.

In spite of these and some other objections, the book is recommended for a large public because of the good arrangement of the material and the excellence of the illustrations.

H. U. Sverdrup

Scripps Institution of Oceanography

Psychology for the armed services. Edwin G. Boring (Ed.). (Prepared by a Committee of the National Research Council.) Washington, D. C.: The Infantry Journal, 1945. Pp. xvii + 533. (Illustrated.) $3.00.

Psychology is a point of view which this timely text brings to bear on the manifold problems of war. Here the psychologist regards himself as a human engineer and presents his discussions of human capacities and limitations as other engineers might do for their materials. In past ages every captain of a military group of necessity has had to think about his men, their training, discipline, fighting strength, reactions to each other and to the enemy, and of home conditions left behind. World War I brought many psychological factors to the attention of military leaders, and the general public became conscious of these matters. This arousal was to be expected from the general advance of the science of human behavior. In part, also, it was due to the promptness with which American psychologists, following the declaration of war by the United States on 6 April 1917, organized themselves to promote the useful applications of their science within our Armed Forces. The dozen or more active committees then formed under the jurisdiction of the National Research Council made notable contributions, but work in these fields was largely stopped in November of 1918.

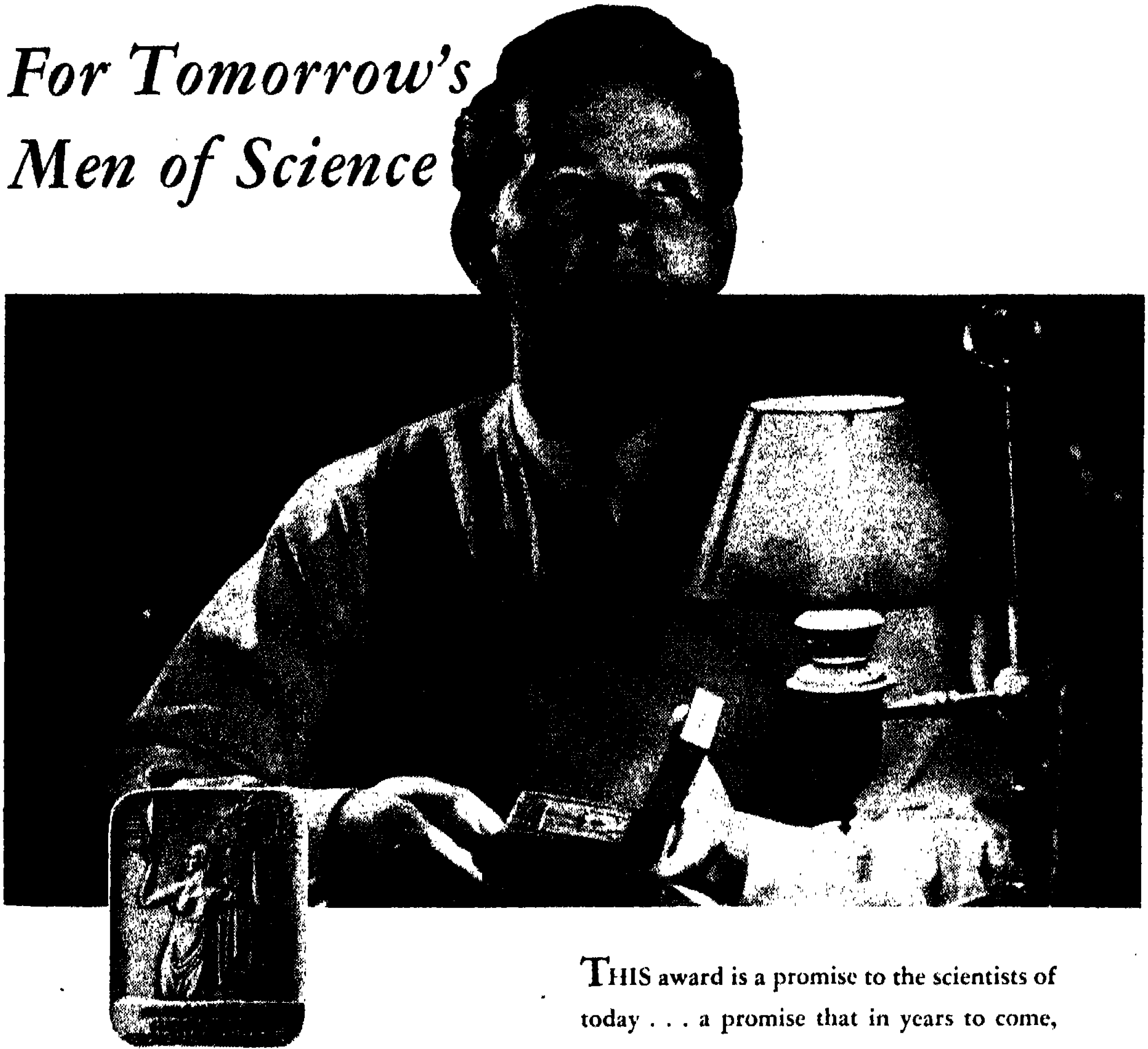
The second World War witnessed an enormous expansion in military psychology. In Germany the developments constituted a part of the Nazi scheme of preparation. The Nazi Government established a psychological general staff group that functioned under their high command through the Ministry of Propaganda and the secret police. There were set up divisions for research, tests, defensive morale, and offensive morale. In the United States the reorganization of psychologists for military purposes took place as an emergency measure with slow beginnings late in 1939. The Navy and the Army reacted promptly to the needs as they became revealed. They welcomed the assistance and consultation of psychologists, and presently were inducting them in wholesale lots and even making arrangements to train more of them. Finally, there was a total of approximately two thousand psychologists devoting full-time work to the war, in addition to those not in uniform who were aiding in research and other allied activities.

The unique psychology text under review is not a history of the participation of American psychologists in the war just ended. This book appeared too early to record the technical achievements and advances recently accomplished in the realm of military psychology. Most of these developments are still not released for publication. The significant and basic contribution made by this volume is its ordered and integrated presentation of the principles and main facts of psychology as they have bearing on, and application to, the problems of the military man, soldier or sailor, general or admiral. Dr. Boring, with consummate skill and with a background of learning and experience that has eminently fitted him for his task, has edited[1] a book which, in nontechnical language and great clarity of style, presents known facts about human traits and capacities and describes the special techniques that have been used in the past for assessing human capacities and controlling human behavior. Through a multiplicity of well-chosen examples he has spared no pains to show how these psychological concepts and techniques are directly applicable to the situations imposed on the individual by the military life and régime. He reveals how and where new techniques peculiarly applicable to the military situation develop or tend to develop.

The main body of the text begins with a consideration of man's sensory and perceptual equipment viewed as military resources. The general facts of vision and visual perception are presented clearly and authoritatively; then promptly the discussion heads toward concrete military problems having to do with vision, as, for example, in height-finding, the stereoscopic examination of reconnaissance aerial photographs, and the adaptation of the eye for night vision observation. There is an excellent chapter on color and camouflage, about which Dr. Boring writes with great competence, since he served

---

[1] This volume was prepared by a committee of the National Research Council composed of the following individuals: G. W. Allport, W. V. Bingham, I. L. Child, Col. J. I. Greene, E. R. Guthrie, H. S. Langfeld, Col. E. L. Munson, Jr., Marjorie Van de Water, and E. G. Boring, *chairman*. Various collaborators prepared some of the materials for thirteen of the twenty-four chapters. Eleven chapters were written by Dr. Boring.



For Tomorrow's Men of Science

The Bausch & Lomb Honorary Science Award is made annually to boys and girls who show unusual proficiency in science subjects. Inaugurated in 1932, it has been accepted by preparatory and high schools as an inspiration to these gifted young people to encourage their scientific endeavors.

BAUSCH & LOMB
ESTABLISHED 1853

THIS award is a promise to the scientists of today . . . a promise that in years to come, there will be an increasing number of young people who are able and willing to carry the torch of science. Inaugurated fourteen years ago, the annual Bausch & Lomb Honorary Science Award has spurred many students to still further scientific study. Many have gone on to create for themselves outstanding careers in science. Of these young people, Bausch & Lomb is proud . . . proud also that it has had a part in providing an incentive for their first endeavors. Bausch & Lomb Optical Co., Rochester 2, N. Y.

"A LABORATORY CLASSIC"

THE MICROSCOPE

By Simon Henry Gage

Late Professor of Histology and Embryology, Cornell University

This outstanding reference which has been used for many years by both beginning student and experienced worker is regularly revised to include the latest developments in the science of microscopy. Now in its seventeenth edition (1941) it contains new information on such important subjects as the electron microscope, polaroid, plastics as mounting media, and high-pressure mercury lamps.

The student wishing to gain a thorough foundation in microscopy will find in this book simple, easy-to-follow explanations of the principles of the microscope and directions for the use of the instrument, further clarified by numerous illustrations. For the more advanced worker, the newer and more fundamental methods in microscopy are described, to keep him abreast of advances in microscopical science and techniques.

"A laboratory classic that has passed through many editions, this book is kept strictly up-to-date with each new appearance."—*Science News Letter*

"By far the best known and most widely used of all references on this subject in America."—*Nature Magazine*

617 pages, 313 illustrations,
8vo, cloth. $4.00

•

ORDER FROM YOUR BOOKSELLER OR

COMSTOCK PUBLISHING CO., Inc.
124 ROBERTS PLACE ★ ITHACA, NEW YORK

during the war as a consultant in this field. The discussion is supplemented by a dozen or more well-chosen photographs, mostly of military origin. The physiological and psychological facts about the ear and hearing gleaned from long research in these fields are related to problems of deafness, malingering, telephonic communication, the effects of noise, and sound camouflage.

Two chapters on working efficiency deal with physical conditions, such as temperature, altitude, alcohol, tobacco and other drugs, and also with the influence of work habits, sleep and boredom in relation to fatigue and accidents. The seven rules given for determining the best method of work in any operation deserve wide consideration in the postwar period as well as in the emergency of total war.

Three chapters are devoted to selection of men, learning, and Army teaching, respectively. These deal with general ability, special abilities, jobs, individual differences, and the technique of classification and assignment; the nature of learning, reinforcement and inhibition, study, rapid reading, memorizing, and recognition.

About one hundred pages are devoted to the treatment of motivation and morale, personal adjustments, emotions, sex, and leadership. The primary and secondary needs of the individual are clearly and adequately described. His methods of meeting these needs are discussed and compared. Particular attention is given to frustration, its frequent occurrence under military life, and the ways in which it may be dealt with. The chapter on emotions centers on fear, fighting fear and anger, and the psychological bases for their use and control. The review of sex needs and problems is more frank, objective, and devoid of platitudes than has heretofore been the case in elementary psychology texts in the English language. The psychological principles underlying the acceptance of leadership and the efficacy of leadership have often been written about, but in a single chapter of twenty pages this subject has probably never been covered more comprehensively.

The last hundred pages of *Psychology for the armed services* deal with those aspects which arise out of social psychology, such as rumor and its control, panic and mobs, the assessment of public opinion, its technique and reliability, propaganda and the methods of psychological warfare, and the differences among the peoples of the world.

This text was preceded by two earlier volumes, both pocket-sized books prepared under the direction of the same committee of the National Research Council: *Psychology for the fighting man*, edited by E. G. Boring and Marjorie Van de Water, and *Psychology for the returning serviceman*, edited by Irvin L. Child and Marjorie Van de Water, both sold in large editions. *Psychology for the armed services* represents the consummation of the objectives set by the committee. It covers more thoroughly many of the subjects treated in the two earlier volumes. There is a very adequate index, and for each chapter, except the summary, an annotated bibliography is supplied. There are many concise summaries and sets of psychological rules. They are not paraded, even in the index, but must be sought out in the contexts where they occur. During the next few years when former GI's form a large segment of our college population, this book will find wide usefulness as a text for beginning courses in psychology and will be outstandingly productive of class discussions. But it will also find a place on the bookshelf, within arm's reach, of many a military man and his industrially-minded brother.

Walter R. Miles

School of Medicine, Yale University

Scientific Book Register

Albeaux-Fernet. *Les hormones en therapeutique.* Paris: Legrand et Bertrand.

Arcieri, John P. *The circulation of the blood and Andrea Cesalpino of Arrezzo.* New York: S. F. Vanni, 1945. Pp. 196. (Illustrated.) $4.00.

Baillif, Ralph N., and Kimmel, Donald L. *Structure and function of the human body.* Philadelphia: Lippincott, 1945. Pp. 328. (Illustrated.)

Barclay, Alfred E., *et al.* *The foetal circulation and cardiovascular system, and the changes that they undergo at birth.* Springfield, Ill.: Charles C Thomas, 1945. Pp. 727. (Illustrated.) $6.50.

Beals, Ralph Leon. *The contemporary culture of the Cahita Indians.* Washington, D. C.: Government Printing Office, 1945. Pp. 256. (Illustrated.) $.05.

Benham, H. E. *Aerial navigation.* New York: Wiley, 1945. Pp. 351. (Illustrated.) $4.00.

Bourne, Aleck W., and Williams, Leslie H. *Recent advances in obstetrics and gynecology.* (6th ed.) Philadelphia: Blakiston, 1945. Pp. 357. (Illustrated.) $5.50.

Briscoe, Herman T., *et al.* *A laboratory manual of general chemistry.* (2nd ed.) Boston: Houghton, 1945. Pp. 326. (Illustrated.) $2.00.

De Broglie, Louis. *De La mécanique ondulatoire a la théorie du noyau.* Paris: Hermann.

Delaunet, Adrien. *La penicilline.* Paris: Presses Documentaries. Pp. 90.

Felsen, Joseph. *Bacillary dysentery, colitis and enteritis.* Philadelphia: Saunders, 1945. Pp. 632. (Illustrated.) $6.00.

Freeman, Henry. *Deutsch-englisches Fachworterbuch der Metallurgie.* Ann Arbor, Mich.: J. W. Edwards, 1945. Pp. 327. $6.25.

Hayes, Ralph W. *Trees and forests of Louisiana.* Baton Rouge, La.: State University, Bureau of Educational Materials, Statistics and Research, 1945. Pp. 96. (Illustrated.) $.15.

Jeans, Sir James. *The astronomical horizon.* New York: Oxford, 1945. Pp. 23. (Illustrated.) $.75.

Landis, Paul H. *Adolescence and youth: the process of maturing.* New York: McGraw-Hill, 1945. Pp. 483. (Illustrated.) $3.75.

Lichte, Hugo, and Narath, A. *Physik und Technik des Tonfilms.* (2nd ed.) Ann Arbor, Mich.: J. W. Edwards, 1945. Pp. 419. (Illustrated.) $12.50.

MacColl, LeRoy A. *Fundamental theory of servomechanisms.* New York: Van Nostrand. Pp. 148. (Illustrated.) $2.25.

Manley, R. G. *Waveform analysis: a guide to the interpretation of periodic waves, including vibration records.* New York: Wiley, 1945. Pp. 286. (Illustrated.) $4.00.

Mather, Rufus Graves. *Excavating buried treasure.* Cambridge, Mass.: Harvard, 1945. Pp. 123. (Illustrated.) $4.00.

McLaughlin, George Dunlap, and Theis, Edwin Raymond. *The chemistry of leather manufacture.* New York: Reinhold, 1945. Pp. 810. (Illustrated.) $10.00.

Pliny. *Natural history.* (Vol. IV.) Cambridge, Mass.: Harvard, 1945. Pp. 571. $2.50.

Rayleigh, John William Strutt. *The theory of sound.* (2nd ed., rev.) New York: Dover Publications, 1945. $4.95.

Rieche, Alfred. *Alkylperoxyde und Oxonide: Studien über peroxydischen Sauerstoff.* Ann Arbor, Mich.: J. W. Edwards, 1945. Pp. 180. (Illustrated.) $3.50.

Sachanen, Alexander Nicholas. *The chemical constituents of petroleum.* New York: Reinhold, 1945. Pp. 451. (Illustrated.) $8.50.

Sagarin, Edward. *The science and art of perfumery.* New York: McGraw-Hill, 1945. Pp. 279. (Illustrated.) $3.00.

Verdoorn, Frans. (Ed.) *Plants and plant science in Latin America.* Waltham, Mass.: Chronica Botanica, 1945. Pp. 424. (Illustrated.) $6.00.

Verdoorn, F., and Honig, P. (Ed.) *Science and scientists in the Netherlands Indies.* Waltham, Mass.: Chronica Botanica, 1945. Pp. 491. (Illustrated.) $4.00.

———. *Vitamin A in butter.* Washington, D. C.: Government Printing Office, 1945. Pp. 18.

———. *Le cancer.* (Ligue francaise contre le cancer.) Paris: Masson. Pp. 106.

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Specialized nutritional research products. Investigators studying nutritional deficiencies will be interested in a small catalogue of research preparations which have been standardized by the General Biochemicals Company. In addition to the many items which the company has pioneered in the past, two new products are listed. One is a "Yeast Supplement Solution" for microbiological procedures and the other is a "Basal Medium Stock Solution." The latter was developed to supply scientists with a complete medium suitable for microbiological Riboflavin Assay, U. S. P. XII. The former product is suitable for individual manipulation according to the research being undertaken. *Special products for nutritional research, Catalogue SC–461.* General Biochemicals, Inc., Chagrin Falls, Ohio.

Penicillin ointment. The control of certain infections may be possible by local penicillin therapy; others may require combined topical and parenteral administration. Based on research and clinical studies, Schenley Laboratories have prepared a penicillin ointment for topical application. The use of topical therapy for such infections as *sycosis barbae*, *sycosis vulgaris*, chronic infectious dermatitis, and folliculitis is described in a small brochure recently released. *Penicillin ointment Schenley, Brochure PB130–1 SC461.* Schenley Laboratories, Inc., 350 Fifth Avenue, New York 1, N. Y.

Sound films for science teaching. The Encyclopaedia Britannica Films Company has just issued an interesting and helpful outline of the film content of several hundred films now in regular stock. In addition to a description of the film, information is given about the collaborators and suggested uses in the classroom. Instructors who are just starting to use films will find the glossary of "film words" and projection suggestions of considerable help. *Classroom films (sound), Booklet KW SC–461.* The Encyclopaedia Britannica Films, Inc., 20 North Wacker Drive, Chicago 6, Ill.

Fine mineral specimens. The current annual edition of fine mineral specimens which the Ward's Natural Science Establishment issues has just reached this office. It is a price list with descriptions of individual mineral specimens suitable for the collector of classroom or museum exhibits. The minerals listed range from Acmite to Zuynite. Interestingly enough is the note that Uraninite cannot be shipped by mail. *Fine mineral specimens, Catalog 456 SC–461.* Ward's Natural Science Establishment, Inc., Box 24, Beechwood Station, Rochester 9, N. Y.

Electrical measuring instruments. The Weston Electrical Instrument Corporation has sent in its new catalogue of instruments. Included are laboratory and portable standards, testing portables, switchboard instruments, panel instruments, relays and controls, tachometers, thermometers, aircraft instruments, etc. The descriptions are unusually complete with technical specifications, diagrams, illustrations, and prices. *Weston electrical instruments, Catalog 13–A SC–461.* Weston Electrical Instrument Corporation, Newark 5, N. J.

Flame photometry. The increasing importance of trace elements in modern research and production emphasizes the need of a faster, more accurate method of analyzing for the presence of sodium or potassium in other elements. In answer to this need the Perkin-Elmer Corporation is presenting a new instrument, the Flame Photometer, which enables these difficult analyses to be performed faster and more easily than is possible by any other method. It permits direct reading, quantitative determination of sodium and potassium individually, in the presence of each other and of all other common elements. With this new instrument the time required for a routine analysis for both elements is less than 2 minutes when an accuracy of plus or minus 3 per cent is satisfactory, and less than 20 minutes when 1-per cent accuracy is needed. Extreme sensitivity on a small sample can be obtained, since one microgram in 16 cc. of solution (0.1 p.p.m.) can be detected. *The Perkin-Elmer Flame Photometer, Model 18, Bulletin SC–462.* The Perkin-Elmer Corporation, Glenbrook, Conn.

Photographic materials for spectrum analysis. The Eastman Kodak Company has recently published a handbook on the photographic problems related to spectrographic analysis. Illustrated with charts, graphs, and reproductions of spectroscopic plates, the handbook gives useful information on a wide range of topics. Among the subjects covered are: the properties of plates and film; precautions in photographic photometry; choice of photographic material; processing; storage of photographic materials; handling of plates and films. Data sheets give the important facts about ultraviolet and infrared sensitive films and plates. *Kodak materials for spectrum analysis. Handbook SC–462.* Eastman Kodak Company, Rochester, N. Y.

Biological supplies. The 1945–1946 catalogue of the General Biological Supply House, Inc., has just reached this office. Its 416 pages list the thousands of biological items carried in stock by this house. Among the new listings to be found in this edition are bacteria and mold cultures, new key cards and quiz sheets, special anatomy charts, improved microscope and Kodachrome slides, and plastic embedded specimens for display and demonstration purposes. *Turtox biological supplies. Catalog No. 12 SC–462.* General Biological Supply House, Inc., 761 East 69th Place, Chicago 37, Ill.

SCIENCE

Vol. 103, No. 2665 Friday, January 25, 1946

An Industrial View of Research Trends[1]

M. L. Tainter, Director of Research

Winthrop Chemical Company, Inc., Rensselaer, New York

CONSIDERATION OF RESEARCH TRENDS from the standpoint of industry calls for an evaluation of the shortage of men and women with scientific training and the relationship of industrial research to research in government agencies and universities; possible or prospective changes in our patent laws also must be weighed. The first and most pressing need is quickly to adjust industrial research to the greatly modified conditions brought about by the dislocations of the war. The second is to adapt it to the changes resulting from the tremendous commercial expansion of this country.

Everyone is aware of the growing inflationary trend whereby all things are becoming more costly in terms of dollar values. Because of governmental controls to combat inflation, increases in selling prices of goods have been held down in relation to the cost of developing or producing the products. This has resulted in research becoming much more expensive in proportion to the profit on the product output.

Inflationary trends, coupled with the shortage of skilled personnel, have raised the salaries of research workers to a figure well beyond any previous level. In our particular field the research laboratories are paying Ph.D.'s, just out of school with no special experience and only average ability, initial salaries which are approximately double those which the superior graduates received in academic or research positions ten to fifteen years ago. Men of somewhat greater experience and ability expect, and are receiving, salaries greater than those of most university professors, at a time when their technical skill and experience are equivalent to those of perhaps only university instructors or assistant professors. Not only have the salaries advanced to new high levels but the costs of chemicals, glassware, and other items of operating expense have gone up, so that the total cost of running laboratories is approximately double what it has been previously. One result of this increased cost of research is that problems have to be evaluated most critically now that they cost so much more to investigate. Another side of the same picture is that if a fixed budget is being maintained, the total amount of research which can be accomplished is limited by the greater expense of each project.

It would appear that industry is in a better position to meet this particular situation than are laboratories of the Government and universities. Industry will be able to adjust the selling price of the products it manufactures to their new cost as soon as there is a return to conditions of free competitive enterprise. Government also is undoubtedly better off than the universities as far as research cost is concerned, although, in response to the demand to reduce taxes, the availability of funds for governmental research will be more limited than under wartime conditions.

As a result of the tremendous growth of American industry there has been a remarkable increase in the amount of industrial research during the past two decades. At the present time industrial organizations are doing probably twice as much research as all other agencies in the country combined, especially if emergency-induced war research is excluded. The figures are not completely available for recent years because of various war-imposed restrictions. However, the general position is rather clearly indicated by Table 1, which was presented in Vannevar Bush's report to the President, entitled *Science, the endless frontier.*

The shift of research towards industry creates problems which must be carefully considered. Industrial research traditionally has consisted primarily of developing and perfecting the application of the fundamental discoveries made in noncommercial laboratories. Development of new fundamental knowledge cannot be maintained at adequately increasing rates if university research does not accelerate with the industry which it feeds. For this the universities need more income. The greatest deterrent to the growth of university research funds is present tax regulations, which hamper donations of money. Modification of existing tax laws and rulings could be readily made so that such donations would be stimulated to the point of restoring the universities' relative position in the country's research. Such a means of accomplishing this objective would be highly desirable, since it would place the control of the spending of such money in the hands of skilled university administrators whose success with such funds has been amply demonstrated.

---

[1] Presented as part of a panel discussion of "Science in the Postwar World" before the Eastern New York Section of the American Chemical Society, 18 October 1945.

TABLE 1

SCIENTIFIC RESEARCH EXPENDITURES

Year	Industry	Nonprofit industrial research institutes	Goverment (Federal and State)	Colleges and universities	Research institutes	Total scientific research expenditures
	Millions	*Millions*	*Millions*	*Millions*	*Millions*	*Millions*
1920	$ 29.4	....	....	...	..	....
1921	37.4	....	....	...	..	....
1922	44.0	....	....	...	..	....
1923	50.0	....	$ 15.6	...	..	....
1924	58.0	....	16.3	...	..	....
1925	64.0	....	18.0	...	..	....
1926	70.0	....	16.9	...	..	....
1927	75.9	....	17.1	...	..	....
1928	88.0	....	17.7	...	..	....
1929	106.0	....	22.8	...	..	....
1930	116.0	$ 0.56	24.0	$20.3	$5.2	$166.1
1931	131.3	1.2	26.9	...	5.2	....
1932	120.0	0.99	40.0	24.8	5.1	191.0
1933	110.2	0.74	....	...	4.8	....
1934	124.0	1.5	22.2	19.2	4.7	171.8
1935	136.0	2.4	25.8	...	4.7	....
1936	152.0	2.5	33.8	25.0	4.7	218.1
1937	160.0	3.5	40.7	...	4.6	....
1938	177.1	4.0	49.3	28.4	4.5	263.7
1939	200.0	5.0	....	...	4.5	....
1940	234.0	6.1	69.1	31.4	4.5	345.2
1941	....	9.1	207.2	...	..	....
1942	....	14.0	332.1	39.5	..	....
1943	....	....	561.5	...	..	....
1944	....	....	719.8	...	..	....

From Bush, Vannevar. *Science, the endless frontier: a report to the President.* Washington, D. C.: U. S. Government Printing Office, 1945. P. 80.

If the universities are not enabled to carry on their fundamental researches at a pace commensurate with the need, then industry, as a matter of self-protection, will have to devote increasing attention to this type of research problem. Probably this would be desirable in the long run. Some industrial organizations are now actively promoting such studies; however, their contributions form only a small part of the total fundamental discoveries being made. Before this type of investigation can be pursued by industry to an adequate degree, management will have to be convinced of the necessity of such studies. The directors of research will have to demonstrate to Boards of Directors that money spent in such research is as productive in the long run as is applied research designed for immediate commercial application. Whole new industries can spring up as a result of fundamental research if this is developed under sound leadership. The important thing is to uncover new fundamental facts, for there will be good prospects of finding manifold practical applications of them. Good recent examples of this type of development are found in the plastic industries and in the production of nylon and related products as a result of the study of the fundamental chemistry of high molecular weight polyamide polymers. Another is based on the thermionic tube, which was made possible only by fundamental discoveries on the behavior of gases in a vacuum.

A serious implication of the shift to industrial research is the change this is producing in the availability of trained scientific personnel. Industrial research laboratories depend almost exclusively on *university-trained scientists for the direction and* prosecution of their research programs. If universities become overshadowed by industrial research activities, it will be increasingly difficult for them to retain qualified investigators who are capable of training the research men of the future. Not only does this involve routine classroom instruction, but also those intangible qualities of inspiration and leadership. One of the most valuable qualifications for a university scientist is an ability through personality, force of character, and enthusiasm for his subject to attract to him and to the subject he represents neophytes eager to join him in enjoying the beauties of his field. These qualities of leadership also make him a desirable man for an industrial research post. If the academic scientist has to leave the university to earn an adequate livelihood for his family, not only is the university bereft but also industry, which is depending upon him to recruit and train its future research workers. The answer to this is obvious: it is to the long-term advantage of industry to see that university professorships remain attractive enough to compete on equal terms for the personnel needed for educational functions.

The problem of trained personnel has been greatly accentuated by the developments occasioned by the war in the last few years. No one could reasonably have anticipated that the National Government, poorly advised by those on whom it relied, would cut off the supply of future scientists by compelling the reckless siphoning of these individuals into the military services. One of the most serious blunders of our wartime policies was the failure to jealously husband our present and prospective scientific workers so that the strength of the nation could be fortified through increased research development, rather than weakened. This viewpoint has been publicly reiterated by many of our most influential scientific leaders without eliciting any persuasive or convincing official explanation of the motives or reasoning alleged to justify such draft policies. A heavy load of responsibility rests on the shoulders of those who condoned, if they did not actively advise, this widespread, indiscriminate drafting of present and potential scientific workers. The extent of the diversion of manpower from research as exemplified by the Ph.D. group has been summarized by Dr. Bush's committee (Table 2). It will be realized immediately that these sixteen thousand research scientists diverted to war were entirely inconsequential from the standpoint of military manpower needs in view of the fourteen million people we had under arms. However, withdrawal of this many from the research group represented a percentage loss to research which will require a decade to overcome.

TABLE 2

DEFICIT IN SCIENTIFIC PERSONNEL

	Accumulated deficit, 1941 through 1944	Estimated deficit, 1945	Total 1941 through 1945	Probable deficits, 1946 through 1955	Total probable deficit due to war, 1941 through 1955
Chemistry	240	550	790	4,460	5,250
Engineering	148	82	230	730	960
Geology	63	50	113	317	430
Mathematics	161	100	261	939	1,200
Physics	251	160	411	1,589	2,000
Psychology	96	84	180	550	730
Biological Sciences	665	725	1,390	4,910	6,300
Totals	1,624	1,751	3,375	13,495	16,870

From Bush, Vannevar. *Science, the endless frontier: a report to the President.* Washington, D. C.: U. S. Government Printing Office, 1945. P. 171.

Industry must adopt special measures to meet the present and future shortage of trained personnel. One method, which will be of moderate help, will consist of additional training and education of present junior staff members. Upgrading the more capable individuals through promotion of extension courses, special training programs in the industrial laboratories themselves, and other means may in some small part supply additional people at higher levels of attainment.

Another means of helping to fill this gap will be to stimulate the education of new research workers in universities by making their training programs more attractive than others available to the returning veteran. This means that universities must have generous fellowship funds whereby men who wish to return for scientific education can be supported adequately. A man who has been out of college and in the military forces for several years, and has possibly accumulated family responsibilities, has matured to such a degree that he cannot be expected to go back for three or four years of schooling unless his economic position during this period is made not too unbearable. Some financial help will be provided through the re-education programs of the Government, but it is not clear at this time whether such provisions alone will prove sufficiently attractive to tip the balance of distribution in any significant manner.

Another means by which industry might help meet the manpower shortage is by creating joint research programs with universities and research institutes. This would, in essence, make these endowed or academic research laboratories extensions of the industrial organizations. Any such widespread program would be dangerous for both industry and universities unless it were carried out with great circumspection. For industry to depend upon university scientists for any considerable part of its research would be to put the universities in the position of having to accept research projects, time schedules, and the other attributes of industrial research which would not properly fit into the academic scene.

If a university scientist is induced to supplement his income by conducting a significant amount of research for industry, then this cannot help but divert his interest, and a disproportionate share of his energy, from his primary academic functions. It is true that university professors can contribute effectively to industrial programs by giving periodic advice along the lines of their special knowledge and training; but when the association goes further than this, it must be at the expense of the universities' needs. Therefore, the industries should restrict their demands on the academic scientists, primarily relying on them to a limited degree as consultants in fields of their special interests. Industry should also support, as far as its resources permit, the fundamental research and educational programs of the man or the institution through grants of fellowship funds. To the largest possible degree these grants should be entirely unrestricted so that they could be used either to promote training in research or to expand fundamental research without regard for its commercial implications. The grants should not be used as levers, even indirectly, to force the prosecution of applied researches of immediate commercial value. For this latter type of work special short-term arrangements should be made.

Some in industry feel that a serious problem presently to be faced arises from the accelerated development of governmental bureaucracy in research. Under the impact of wartime necessity, numerous research projects were set up under governmental auspices to obtain answers to specific questions in the shortest possible time. These projects drew freely and practically without restriction on the trained personnel of the country. Almost without exception they had the best ability of the country at their command; their funds were, for all practical purposes, unlimited. As a result of the intensive work which this made possible, numerous important problems were advanced rapidly to stages which would have been reached only after many years under ordinary peacetime conditions. An unfortunate aftermath is that there is a possibly natural tendency, especially in those participating in these programs on a full-time basis, to feel that they have a vested interest in the continuation of the programs beyond the time of the national emergency which necessitated or justified them.

Consideration of the monetary and manpower-hour expenditures on these governmental wartime research projects as a whole reveals a low scientific return on the investment. This is not because of any failure of the persons involved to contribute their best efforts, but rather results from the inherent nature of the situation. The expenditure of even millions of research dollars at a forced draft rate is not an adequate substitute for original ideas. Without fertilization by the flashes of genius which break open new fields for investigation and point out unexplored concepts, the piling up of manpower hours simply multiplies the accumulation of relatively inconsequential details. Many of the war-inspired research programs demonstrate eloquently that piling up data and expending money in a research program cannot make up for the lack of novel concepts worthy of such extensive study. The great hazard in all the present proposals of governmental stimulation of research through subsidies arises from the fundamental truth that large volumes of research are not often adequate substitutes for high quality and originality.

Another danger in the mass approach to research, particularly in peacetime and where the funds are supplied from governmental sources, is that it might put the educational institutions at the mercy of administrators whose ability in the political manipulations required to get appointments would outweigh their qualifications as scientific executives. In the hands of irresponsible theorists such bureaucratic research projects could become instruments for promoting ill-conceived and unscientific political, economic, or social philosophies. The recent history in Europe provides sufficient tragic examples of the perversion of research by government to demonstrate that these possibilities are not entirely imaginary. The leverage provided by the administration of the huge research funds proposed could dislodge the entire balance between our present educational system and industrial research if not exerted with consummate skill.

The viewpoint seems to be held in certain governmental circles that size and economic prosperity are synonymous with social undesirability. There appears to be a tendency to want to discredit the methods of organizations which have been outstandingly successful, simply because of their success. An example of this is the attack on our patent system. One proposal which is being actively discussed in Washington is to compel licensing of all patents. The idea of the proponents of such a policy is that thereby patents would be made freely available to all, which would result, in some ill-defined way, in an improvement in the general welfare. However, compulsory licensing of patents actually would have just the reverse effect. A patent is a contract between the Government and the discoverer which provides that he can have exclusive use of his invention for a limited period of years in return for making it freely available to everyone thereafter. If availability for use by all, even at a license fee, is to come from the moment of disclosure of the invention, then there usually would be little reason for having a patent. The welfare of the inventor would be much better advanced by keeping his invention secret for commercial exploitation. Thereby he could maintain for a longer time the monopoly which he had created for himself through the stroke of genius which constituted his invention. A further serious consequence of compulsory licensing of patents would be to decrease the amount of patenting and disclosure thereby of new scientific information. At present, patents constitute an important part of the scientific literature. This would be choked off if patenting were discouraged by compulsory licensing regulations.

Some argument is made that compulsory licensing of patents would keep powerful companies from preempting entire fields of commercial development through broad, multiple-patent coverage. This argument gains whatever force it may have by being tied to the assertion that, through such patent control, small industry or the small businessman is being squeezed out of the competitive picture. It is difficult to see how the compulsory licensing of patents would modify the fact that a large, well-run company might be able to manufacture some item and to distribute it more economically than a small organization which lacks the resources and trained personnel of its larger rival. If there were compulsory licensing of patents, the small manufacturer would be worse off than previously, because he would have no way of maintaining an exclusive market for the product of his invention during the period needed for its preliminary commercial development and establishment on a firm business footing. The result of compulsory licensing would simply be the expansion of the large efficient units at the expense of the smaller ones.

If there is misuse of patents by industry to create unjustified monopolies or to extend them beyond the bounds which are prescribed by law or which are socially desirable, then there is adequate redress available in the various enactments bearing on restraint of trade, unfair competition, antitrust acts, etc. These can meet any legitimate need of the circumstance and have, of course, already been widely used for this purpose.

Finally, if industry and industrial research are to continue increasing in strength and productivity and thereby contribute to national welfare, they must have an atmosphere of assurance that they will be permitted to reap a fair reward for the results of their researches. In such an atmosphere of confidence the leaders of industrial research will feel that they stand on firm ground, from which unparalleled progress is inevitable.

Study of Experimentally Deformed Rocks[1]

Eleanora Bliss Knopf

Chairman of the Committee on Experimental Deformation of Rocks, National Research Council

THE TIME HAS FINALLY COME when research no longer has to be restricted to purely military objectives. A particularly important subject for postwar geological research is the continuation of the study of experimental rock deformation that just got off to a good start when it was necessarily interrupted by wartime activities. At the request of the chairman of the Division of Geology and Geography of the National Research Council a Committee on Experimental Deformation of Rocks was organized in 1944 in connection with postwar planning in order to formulate a systematic program for the work, a sort of target at which to shoot in postwar research.

A special microscope technique, known as petrofabric analysis, which has been perfected during the last twenty years, has made it possible to visualize the way in which the more important rock-making minerals, in particular quartz, calcite, mica and feldspar, are arranged in rocks. This spatial visualization has proved that in practically all intensely folded and metamorphosed rock terranes some vectors in the rock constituents, either dimensional or crystallographic or both, are lined up in certain definite patterns of preferred orientation. That is to say, all the inequidimensional grains of calcite in a marble or of quartz in a quartzite may lie with their longer axes parallel. Or all of certain crystallographic directions such as the optic axis in quartz or calcite, or all of certain crystal planes such as the basal plane in mica, may be arranged in definite spatial patterns. The inference that this preferred orientation in rock constituents is induced by the type of movement followed by the constituents during rock deformation has opened up a new path of investigation of the mechanics of crustal movement.

But as long as the geologist cannot do as the metallographer does with his ductile metals, that is, deform rocks and determine how the position of rock constituents has been changed by the deforming movement, the kinematic interpretation of petrofabric diagrams must remain, like too many other geologic conclusions, a matter of more or less well-justified inference.

We know that these petrofabric diagrams differ in symmetry and in type, but what do these differences really show and how can we *prove* that they mean what we think they must mean? To establish a sound scientific basis for interpretation we must make the components of at least some rocks assume a definite spatial arrangement in response to some definite deforming force.

STRAIN TO RUPTURE

Inasmuch as it is not an easy matter to produce a spatially continuous deformation in such ordinarily brittle material as rocks it is natural that the first experimental work on a known rock fabric was to strain the rock to rupture and to relate the ultimate strength to the fabric pattern. This was first done in 1929 by Drescher, who deformed a marble fabric that had been carefully studied in Innsbruck by Felkel, under the direction of Sander. The material chosen for the test was an Alpine calcite tectonite (marble) that showed no outward evidence of anisotropic structure. However, it was collected from what is known to be a zone of highly deformed rocks and it proved to have a marked preferred orientation. It was deformed in direct relation to the tectonic axes determined by the fabric pattern, which had been established by the work of Felkel. The marble was found to rupture most readily when the compressive force was applied parallel to the plane in which there is the strongest concentration of those crystallographic planes that have long been known to be glide planes in calcite. It also shows the greatest strength when the compressive force is applied normal to this plane.

---

[1] Read before the Section of Tectonophysics, American Geophysical Union, Washington, June 1945.

Five years later Bell investigated a biotite granite in the same way and found that it ruptures most easily when the pressure is applied at an angle of 45° to the plane in which the majority of the biotite leaves are arranged. This fabric, like that of the marble, proved to have a marked girdle pattern, but unlike the marble it showed its maximum strength when the pressure is applied parallel to the axis of the girdle. The marble shows its intermediate strength when compressed in a direction parallel to the axis of the girdle. The difference in strength between the strongest and weakest directions in the fabric is about 38 per cent of the maximum strength in marble and about 15 per cent in the granite. Therefore an apparently disotropic marble has, in reality, a marked anisotropy, which has a definite influence on the crushing strength. *Similarly, in a granite with a strong preferred orientation of biotite this fabric pattern predetermines a perceptible difference in strength in different directions.*

PLASTIC DEFORMATION

In these experiments there was no penetrative intragranular movement that would produce plastic deformation before rupture, so the movement merely broke the spatial continuity in the fabric without rearranging the crystalline grains. When the brilliant work of Griggs in the laboratory of Professor Bridgman at Harvard finally solved the problem of inducing a plastic deformation of marble cylinders that was perfectly homogeneous as far as could be told from the external shape, the time had come to study the internal fabric of these cylinders and to find out what really happens to the constituent calcite grains during the process of deformation.

The most desirable test material for such an investigation would undoubtedly be a statistically isotropic polycrystalline monomineral aggregate. The Yule marble, quarried by the Vermont Marble Company in Gunnison County, Colorado, is a polycrystalline aggregate and monomineral, being made up of calcite grains alone. It was therefore used for the work. It does not, however, fulfill the other desideratum of a statistically isotropic fabric, in other words a fabric made up of grains in random orientation. Such an arrangement is desirable because in a fabric of random orientation the influence of the deforming movement is free to rearrange the grains in strict conformity to the stress plan, uninfluenced by a pre-existent pattern. That a pre-existent pattern does exert an influence was proved by using the rather simple fabric of the Yule marble. Although this marble appears equigranular on casual inspection it has in reality a distinct planar structure produced by the parallel arrangement of discoid calcite grains. This dimensional preferred orientation proved to be accompanied by a marked crystallographic preferred orientation, in which the optic axes of the calcite crystals lie almost perpendicular to the planar structure determined by the dimensional orientation.

This planar structure was completely transposed by the deforming movement from a vertical position in the test cylinder to an approximately horizontal position in the shortened cylinder. The grains were found to be again discoid and again concentrated in one plane, but the orientation of the plane had changed entirely in response to the deforming movement. Microscopic analysis of the fabric also showed that this horizontal plane of flattening is really a compromise between two planes determined by the crystal lattice structure of the calcite. That is to say, *the maximum concentration of the glide lamellae of the calcite is in two planes, intersecting at a low angle and bisected by the flattening plane. That the original fabric had controlled the course of the movement in deformation* was proved by the very interesting fact that the cylinders, after shortening, had lost their original circular cross-section and had become elliptical. Now if the test cylinder had been cut from a statistically isotropic substance in which all potential directions of movement were the same, the movement would have been free to proceed through the fabric with equal ease in all directions normal to the direction of compression. As the confining pressure was equal on all sides, a differential force in the direction of the cylinder axis should have given rise to an outward movement of material that would be equal on all sides and thus maintain the circular cross-section of the cylinder. Such a movement would have an axial symmetry. The fact that the movement, instead of following such a "cone of shear," followed two "intersecting planes of shear" shows that the movement was actually orthorhombic in its symmetry plan. This orthorhombic symmetry proves that the original anisotropic structure, instead of being wiped out by the deformation, predetermined the axis of intersection of the operative slip planes that caused the deformation. Moreover, fabric analysis showed that the direction of the major axis of the ellipse coincides with the direction determined by the glide line relation between the lamellae and the axis maxima of the deformed calcite fabric. Thus the change in external shape was directly determined by the grain gliding.

SINGLE CRYSTAL DEFORMATION

This anisotropy of the fabric, which has such a marked influence upon the progress of deformation, depends upon the field that is being considered. A polycrystalline calcite fabric of random orientation would be isotropic because the grains are not lined up in a preferred orientation. But if we examine farther into the field of the space lattice of the individual calcite crystal, the field is no longer isotropic, because the movement is no longer free to proceed with equal ease in all directions but is restricted to certain prescribed crystal glide planes in certain prescribed crystal directions.

Therefore, in formulating a program for systematic research on the mechanism of rock deformation the fundamental start should really be to determine the course of the deforming movement in the space lattice of the ionic crystals that make up the rock-making minerals. Much has been found out in recent years about the course of deformation in the space lattices of the easily deformed metal crystals. It remains, however, to the credit of the science of geology that twinning and translation, which are the processes of plastic deformation in metals, were first discovered and carefully studied by mineralogists, in ionic crystals. In later years it has been proved both by metallographers and by mineralogists that the course of deformation follows certain laws, predetermined by the anisotropy of the space lattice. The metallographer has the advantage over the geologist that he can deform his crystals more readily, but he has to contend with the handicap that he can only study the internal rearrangement of opaque crystals by X-ray analysis, whereas modern optical petrofabric analysis of transparent minerals gives an easy preliminary insight into the response of the crystal lattice to deforming movement, and certain ambiguities that may be inherent in the optical method can be solved later by X-ray analysis.

One of the first problems that cries for attention in single crystal research is: What is the relative function of twinning and translation in plastic slip? The metallographer has answered this for metal crystals by the statement that the slip is accomplished both by translation-gliding and by twin-gliding along prescribed crystal planes and in a prescribed crystal direction. The essential differences between these two types of deformation are threefold: (1) The movement in translation can proceed in both senses of the prescribed direction; in twin-gliding it is restricted to one direction sense. (2) In translation the movement can continue uninterrupted until strain hardening brings the plastic deformation to an end. In twin-gliding the movement is homogeneous simple shear of a given part of the crystal lattice for a finite distance that can be computed. (3) This simple shear proceeds for a restricted distance, measurable as a fraction of the interatomic interval; therefore the orientation of the space lattice is changed in the sheared part of the lattice. In translation the movement is a whole multiple of the interatomic distance and is not necessarily homogeneous. The orientation of the space lattice is unchanged; therefore there is no optical means of recognizing the process except in those sections where the offset between the displaced portions of the grain may cause a perceptible irregularity in grain boundary or a fine lamellar structure.

The restricted amount of movement in twinning puts a definite limit upon the amount of extension or compression that can be attained by twinning alone. When the crystal is sheared throughout its whole extent nothing more can happen by twin-gliding. For this reason metallographers ascribe to translation the dominant role in metal deformation where the extension may be several hundred per cent of the length of the undeformed crystal. Twinning, however, plays an important auxiliary part. For example, in deforming a crystal of zinc in tension the deformation starts by translation along the basal plane when the shearing stress along that plane in a given direction has reached a certain critical value. The direction of the applied force remains constant; therefore, as the grain changes shape by gliding, the glide planes are gradually tilted towards the direction of extension and away from the direction of shortening in the crystal. This change finally brings the crystal glide plane into a position where the shearing stress on this plane is less than the critical value necessary for movement and the process slows down. At this stage the resolved shear stress on the twinning plane $\{10\bar{1}2\}$ comes into play and a part of the space lattice will snap by twinning for a limited distance into the position where the basal gliding plane can function once more. In a space lattice such as calcite, where one and the same crystal plane functions as a glide plane both for translation and for twinning, it is not so easy to sort out the difference in operation of the two processes. Even the comparatively low pressure of a knife blade upon the proper edge of a cleavage rhombohedron will produce simple shear in one direction upon the flat negative rhombohedron. This movement can only proceed in one direction sense, towards the crystal axis, whereas translation could proceed in the opposite sense. In order to prove that translation does operate as well as twinning, Bell deformed a calcite crystal by applying the force in such a way that the crystal could not yield by twinning. The calcite then moved in the same plane as before but in the opposite direction sense. Such movement must therefore be translation-gliding.

Griggs got some highly interesting and complex results by deforming a single crystal of Iceland spar. He obtained a homogeneous deformation of 7 per cent by applying a differential force of almost 2,800 kg./cm.^{2} at room temperature to a crystal under a hydrostatic pressure of 10,000 atmospheres. The test cylinder was cut with the long axis parallel to an edge of the cleavage rhombohedron, in other words nearly parallel to one of the three possible flat rhombohedral glide planes. However, there is an ambiguity in the orientation, as the position of the crystal axis in the undeformed cylinder is not known. Four sets of glide planes were developed, with some indication that both twinning and translation had operated on at least three. But the lamellae pattern is somewhat too complex to justify far-reaching conclusions as to the mechanism of deformation, and although the crystal was selected to be free from all traces of twinning as far as could be judged from external appearance alone, there was no optical or X-ray study of the internal structure. This was in the nature of a preliminary experiment at a time when Griggs was establishing his high-pressure technique and there was no opportunity to repeat the experiment under more accurately controlled conditions. When it is repeated it would be desirable to change the crystal orientation of the test cylinder which was originally selected in order to facilitate the rather difficult operation of cutting the cylinders. In this cylinder, deformed by Griggs, one of the three potential glide planes was nearly parallel to the direction of applied force and therefore immobilized to slip as the resolved shear stress on this plane was zero. Movement could and apparently did occur on the other two potential glide planes. A simpler setup for the purposes of analysis would be a cylinder cut so that the crystallographic c-axis lies in the long axis of the cylinder. The resolved shear stress would then be equal on all the three glide planes, and the shearing stress on two other crystal planes that may possibly operate as glide planes in the calcite lattice, namely, the basal plane and the prism, would be zero, so that they should be unable to function. Moreover, with the crystal c-axis of calcite in the direction of a compressive force the three flat rhombohedral gliding planes should be unable to function by *twinning* as the movement on them would then have to proceed against the compressive force. Any movement on these planes ought therefore to be translation. Cylinders of similar orientation should then be tested in tension with the tensile force applied parallel to the cylinder axis. Such a stress plan is an ideal setup for yield by twin-gliding.

It would be particularly interesting to stop the deformation after it has proceeded a very short distance in order to see what happens in the early stage of the deformation and to compare it with deformation carried to a point where the stress-strain curve indicates considerable strain hardening. This comparison should be carried out on cylinders deformed under identical presure-temperature conditions in which the only variable would be the extent of the deformation. Later experiments should evaluate the effect of varying pressure and temperature conditions.

Two important factors in such a program are: (1) the homogeneity of the test crystal, which should be carefully studied to preclude the possibility of twinning in the original undeformed crystal; (2) a careful setup of the field of stress in its relation to the orientation of the glide planes that are known to be operative in calcite. If the initial orientation of the crystal lattice is known, it should be possible to predict the possibility of translation and of twinning on these planes and to plot the change in crystallographic orientation that would result from first, second and successive generations of twins if the deformation obeys the law of maximum resolved shearing stress. Comparison of the predicted and observed results should give a picture of the actual mechanism of deformation.

The same method of study should eventually be carried on in cylinders, in which the crystal setup is planned to put the maximum resolved shearing stress upon other potential glide planes in the crystal lattice.

DEFORMATION OF POLYCRYSTALLINE MONOMINERAL AGGREGATES

This problem can be studied in much the same way as in the single crystals. A way to determine what are the operative glide planes in such a rock constituent as calcite and how these planes carry the deforming movement is to deform a calcite fabric of simple pattern or a fabric of random orientation (if such can be found) and to measure all the linear elements in the deformed fabrics, grain by grain, and relate all the linear elements in each grain to the optic axis of that grain. We would then know which crystal planes have developed to the point of visibility in each grain and we would also know the orientation of these planes with respect to the stress plan that induced the deformation. It would also be possible to orient the stress field of the deformation in reference to the preferred position of potential glide planes just as was done in the study of the single crystal cylinder, and by checking the predicted against the experimentally acquired pattern we should be able to prove which are the operative glide planes and how they function. Of course this presupposes a simple pattern of strong preferred orientation to start with, which again emphasizes the necessity of most painstaking preliminary analysis of the material to be used for the tests.

Another interesting problem that should be studied in the deformation of polycrystalline aggregates is the relation of the degree of the preferred orientation to the amount of deformation in the test cylinder. If we get a certain degree of preferred orientation and a certain fabric pattern in a cylinder that has attained a 40-per cent deformation, how much would we get under similar conditions if the deformation were stopped at a 20-per cent shortening? One of the experiments in tension carried out by Griggs and Balsley suggests that there is a determinable relation between amount of strain and degree of preferred orientation.

In the experiments carried out by Griggs at Harvard the test cylinders were cut so that the tectonic slip plane of the fabric, which contains the maximum concentration of calcite lamellae, was parallel to the long axis of the cylinder in two of the three sets of test pieces. In the third set this planar structure was normal to the cylinder axis. Unfortunately, although this piece was shortened fully as much as the others, it was impossible to study it because the deformed cylinder crumbled to powder before it could be thin sectioned. The elastic recovery on this specimen was higher than in the other two, but probably the crumbling of the cylinder was not connected with this fact. Possibly the deformation was more intergranular in this specimen, more intragranular in the other two, or possibly the relief of pressure was more sudden in the specimen that crumbled than in the other two. This experiment of compression normal to the major slip plane of the fabric should be repeated.

Still more important experiments should be made upon cylinders cut so that the resolution of shear stress on the slip plane of the fabric should be a maximum, in other words at 45° to the tectonic slip plane, *of the original fabric.* Here the deformation should be a maximum.

TENSILE STRESS

Griggs and Balsley obtained marked deformation of as much as 24 per cent in Yule marble cylinders strained in tension under 10,000 atmospheres confining pressure. They used three test cylinders cut with the same orientation as the cylinders used in the compression tests. Their experiments attained a much higher degree of homogeneous deformation than the 9½ per cent extension that Böker had previously obtained in Carrara marble. I have had no opportunity to study these cylinders intensively, and one of the highly desired fields of investigation would be to repeat these experiments with very carefully oriented cylinders and to study the results more intensively than could be done from the single section cut from each cylinder deformed by Balsley.

RECRYSTALLIZATION

Griggs made an extremely important contribution to the technique of high-pressure deformation when he succeeded in producing a beautiful recrystallization texture in Yule marble, deformed at 150° C. in the presence of H_2O and CO_2. This experiment was, however, only of a preliminary nature, and it was only possible to cut one thin section from this cylinder instead of the three mutually perpendicular thin sections that are necessary for a comprehensive fabric analysis. There is also some ambiguity about the orientation of the one thin section that was made; therefore no report has been made upon the fabric. This interesting experiment should be repeated and the results restudied as intensively as possible.

FURTHER WORK

Finally, as the work progresses it should be possible to investigate the behavior of single crystals and monomineral aggregates in shearing stress and also to examine the behavior of polymineral aggregates made up of two or more constituents.

It must be strongly emphasized that, in order to get sound conclusions from the proposed experimental work, the investigation should be carried on systematically, and it is particularly important that work on single crystals and on the *simplest* polycrystalline fabrics that can be found should be carried on under the simplest possible stress plan until procedure can be formulated from the fundamental data as a basis for further investigation.

Research of this kind is slow and arduous, involving much drudgery before we can arrive at broad conclusions. Perhaps this fact should be emphasized to the geologist who is likely to think of research in terms of short programs. As geology becomes more and more an experimental science we are every day extending the scope of our investigations and in a day when much is heard about the necessity for organization of scientific research this should be recommended as one of major importance to geological science.

A National Science Foundation: Will It Be a Practical Reality or a Perpetual Controversy?

I. M. Kolthoff and Maurice B. Visscher
University of Minnesota

WORKING SCIENTISTS have every reason to be extremely uneasy about the likely consequences of the confusing status of scientists' support of legislation in Congress. The testimony of about one hundred representative scientists has been heard in Washington, and a number of questionnaires have been circulated fairly widely. It is apparent that, with negligibly few exceptions, American scientists favor the aims and objects of both of the main bills in Congress, S. 1285 and S. 1720. In fact, the broad objectives of S. 1285, introduced by Senator Manguson, and of S. 1720, introduced by Senators Kilgore, Johnson, Pepper, Fulbright, and Saltonstall, are substantially identical. The major differences involved have been analyzed objectively and carefully by Senator Kilgore (*Science*, 1945, **102**, 630–638), and it is seen that they relate almost wholly to techniques of administration and to patent policy. The new bill, S. 1720, represents a significant compromise on many controversial issues.

It is unfortunate that American scientists have not asked themselves the crucial question about the whole matter: If Congress prefers one or the other of the two bills, is either of them so poorly constructed that it would be better to have no support of legislation by scientists than to have the less desirable of the two? This is really the pertinent question, because perfection is too much to hope for, and a reasonably satisfactory arrangement is all one has a right to demand. If American scientists could stop emphasizing the one or two controversial points and accept what it is clear most of them want, namely the objectives of both of the bills in question, it is reasonable to hope that one of them might be passed soon. If not, the Congress is likely to throw up the job as hopeless and let scientific research starve again for lack of support.

It would seem that there are no insuperable barriers to satisfactory operation in either of the two bills. Their differences regarding patent policy are not of great interest to most scientists in the universities, and it appears likely that the compromise suggested in S. 1720 will largely eliminate criticism from industrial scientists. On the score of the other problem, namely, the method of administration, differences remain, but the advantages of each method are counterbalanced by disadvantages which make the net differences small.

Recently a group of scientists under the leadership of Professors Harlow Shapley and Harold C. Urey have said: "The signers of this statement have a profound conviction that a program of federal aid to research is vital to the national interest and that legislation acceptable if not wholly satisfactory to those who hold divergent points of view about particular questions of function and organization can be drafted. We stand ready to cooperate in the revision of the bills recently considered at the Senate hearings on pending national science legislation. Our purpose is to serve the national interest by securing the collaboration of the maximum number of qualified scientists in a united attack on the scientific problems confronting the nation."

We are in full accord with this view and go one step further, namely, to say that, as the bills now stand, their differences are so inconsequential to the scientific functions they could subserve that the decision as to their exact form should be left to the judgment of the Congress, because public policy questions rather than scientific ones are involved.

We urge our colleagues to express their opinions on the crucial question raised above to their representatives in both Houses of Congress. We have reason to believe that the acrimonious debate over the details of this legislation has led many Congressmen to doubt whether there is actually any form of legislation which would be acceptable to a large majority of scientists and to the Congress itself. If the controversy over the form of administration of public funds is continued, the public and the Congress may easily conclude that scientists are more concerned about the political differences between the two bills than about the scientific objectives which they have in common.

Association Affairs

Work for Section K

Bruce L. Melvin, *Secretary*

Section K (The Social and Economic Sciences) of the American Association for the Advancement of Science today holds a special opportunity and responsibility in our social, economic, and political life to aid in interpreting the problems of society to the physical and biological scientists and to help acquaint the social scientists with the problems invention and discovery are creating. All scientists (social, physical, and biological) have demonstrated their ability during World War II to utilize the techniques and accumulated bodies of knowledge of their own disciplines to meet a crisis. None were found wanting when a common danger faced the country. The spectacular accomplishment of the physicists, the production of the atomic bomb, has forced on both scientists and the public the realization that the cultural lag, discussed many years ago by Dr. W. F. Ogburn, is not just a phenomenon for academic discussion but a poignant reality that must be recognized if peace between capital and labor and peace between nations are to be maintained.

The engineers may invent most efficient heating and cooling systems, and the chemists, synthetic materials, all of which could be used to build clean, efficient, health-conditioning homes, but families continue to live in slums. This is a cultural lag around which cluster major social problems. The most baffling cultural lag is the lack of an adequate international government for the control of atomic energy, especially the bomb. Technology was bringing the nations closer together in 1920 and, as is well known, the speed in eliminating space has been greatly accentuated since that time. Consequently the lag in time is at least twenty-five years; a workable international organization should have been established by 1920. So today nations are trying to adapt their formal relations to a technology heretofore unknown.

Affiliated with Section K are the American Sociological Society, the American Statistical Association, the American Library Association, and the American Econometric Association. The section has also worked closely for many years with Pi Gamma Mu, the Social Science Honorary Society. Frequently the programs at the annual meetings of the AAAS have consisted of special programs given by these different organizations. Sometimes one central theme was followed for all sessions for which the affiliated organizations were responsible, and sometimes not.

The programs of Section K have varied widely over the years; they have been determined by the places of the meetings, the time, and the interests of those in charge. The titles of some of the papers given in 1920 were: Preliminaries of Peace,[1] Effective Means for Readjusting Prices, Magnitude of America's Past in Feeding Europe, Americanization, Public Health, Precious Stones, Engineering Education for Tomorrow's Tasks, The Crime Wave, and Economic Conditions in Peru. Jumping to 1925, the general subject was Research and Progress. Topics covered included: Research in Forestry, Research in the Meat Industry, Future Agricultural Research, Scientific Research as Applied to Concrete Construction, and Administration of Industrial Research. Then, at the 1926 meeting, the general subject was Law Enforcement. This subject would indicate that the Association was interested in the crime wave. A general survey of the field of crime was made, though the causes of crime as they may have rested in our social and economic organization were not examined. Part of the programs since 1926 have emphasized mathematical methodology, while some attention has been paid to planning. More papers have been devoted to population problems than any other field.

Scientists are concerned today as never before about the consequences of the application of their findings. Today men do not engage in scientific research out of curiosity, as it was once said they did. Science, whether called pure or applied, receives its appropriations for practical ends, but just what those ends may do to society is troubling all thinking men. The historical background of Section K makes it especially appropriate that in its programs the social and economic questions which scientific findings are creating should be discussed.

The program of Section K for the St. Louis meeting (27–30 March) is built around the general theme, "The Impact of Technology on Society." This program is designed to portray vividly some of the problematical aspects of modern society occasioned by the advancement of the physical sciences and the lack of adaptation of man to the new conditions created or call it, if you will, the cultural lag. The program will not be a symposium on scientific method or on any subject belonging to any one field, since techniques of any one discipline may be adequately handled in meetings of its own. Moreover, it is hoped that the St. Louis meeting will be the first of a series dealing with the place and responsibility of science and its handmaid, technology, in human affairs. This general plan is built on the belief that the method of science can be applied to all the problems of mankind and that the open-minded investigation of the most prejudiced and "ticklish" questions should be undertaken if they involve individual and social welfare.

---

[1] By David Payne Hill, formerly an Assistant Secretary of State.

During the past fifty years mankind, by sheer reason, has furthered his material achievements more than during the preceding two hundred years. He rides on the wind, has learned to utilize the waves of the ether, has explored to the minutest details the nature of matter, and anticipates that within a very short time he will be able to increase his power infinitely through conquering the atom. Man has accumulated much knowledge and developed techniques in economics, sociology, psychology, etc. Man can control nature: he makes the lightning, the wind, and the water his servants. But has he gained sufficient wisdom to control himself or to live with his fellow men without destroying them?

Man has all the facilities to live in comfort and security, yet never was a feeling of insecurity or distrust in Western civilization greater. World War II indicated that man is more rapacious than when the goods of life were not available, more cruel than when cruelty was that of the savage beast, and more bent on power and prestige than when titles regulated classes. The world is critical of democracy—perhaps more so than when it was only an experiment and when Negro slavery contradicted its existence. Researches have given man millions of mechanical slaves with tireless power to do his bidding, yet Germany, which had this power to lift the standard of life for the world, was unsatisfied without the enslavement of others.

With all these indictments certain common values of humanity are still accepted by scientists and statesmen. Some of these are security, physical and mental health, and certain minimum standards of living. How far are we attaining these for our own people? How close can we come to their general realization? Social problems exist when these goals lie outside the grasp of a large mass of the population. Therefore, it falls within the scope of its activities for Section K to promote research that will bear on the formation of public policy that relates to such problems and to help secure the cooperation of the best thinkers in all sciences as problems in such fields press for solution.

Peace demands more vision, devotion, and cooperation of scientists who will use their techniques, methods, and disciplined minds to maintain it than did war. In war all scientists gave their best efforts to the Government. We know how to win wars; we do not have adequate knowledge of how to solve the problems of peace or those problems that lead to war. The physical scientists are just as anxious to preserve and improve our democratic way of life and keep peace with the rest of the world as are the social scientists. No one group of scientists has all the answers, but by all working together, solutions for the "cultural lag" and other maladjustments of society which are created or augmented by scientific discoveries and inventions can be found. This is the hope of scientists. Section K can provide a forum for just such cooperation.

Scanning Science—

An amendment to the Agricultural appropriation bill has just been sent to Congress providing for a "Director-in-Chief of scientific bureaus and investigations, to serve during good behavior, to have authority to act as Assistant Secretary, and to perform such other duties as the Secretary may direct." This amendment is the outgrowth of an effort to secure a permanent non-political organization and administration of the various bureaus and divisions engaged in the scientific work of the Government, and at the same time bring about a more intelligent and more effective cooperation than has been heretofore possible.

—21 February 1896

Technical Papers

Protein Apoferritin and Ferritin in Iron Feeding and Absorption[1]

S. GRANICK
Rockefeller Institute for Medical Research

The level of iron in the body is relatively constant. Recent studies have indicated that iron, once taken into the body, remained there, the normal rate of iron excretion being negligibly small (*3*). The level of iron then had to be governed by an absorption process in the gastrointestinal tract. Studies by Hahn, Bale, Ross, Balfour, and Whipple (*2*) showed that the gastrointestinal mucosa was indeed the seat of such a regulatory process. The mucosa was found to become "saturated" within a few hours after feeding a dose of iron, and further absorption of iron was prevented for several days. The depletion of body stores of iron resulted in a five- to fifteenfold increase above normal in the rate of absorption of iron. These authors suggested that the "block" of iron absorption might be due to a temporary storage of iron in the mucosal cells, perhaps in the form of ferritin. This storage iron would be in equilibrium with serum iron, and only when the storage iron had been depleted below a certain level would more iron be absorbed.

Recently we have tested this hypothesis in the guinea pig. Advantage has been taken of the great tendency for ferritin to crystallize even in tissue juices. By immersing scrapings of the gastrointestinal mucosa in 10-per cent $CdSO_4$ solution, crystals of ferritin could be observed to form, and the concentration of ferritin in a particular region of the tract could be related to the number and size of the ferritin crystals. In the guinea pig, the two tissues which were found to contain the most ferritin were the liver and the gastrointestinal tract. In these normal, growing animals ferritin in the gastrointestinal tract was found only in the duodenal region, and here only in traces.

When 10-mg. doses of ferrous iron were fed per day, a marked increase in the content of ferritin was noted all along the tract. During the first 24 hours it was mainly found in the upper part of the small intestine. On continued daily feeding of iron it could be found after several days in the walls of the small and large intestines and in smaller amounts in the stomach and even the caecum.

The discovery of ferritin along the gastrointestinal tract, its increase in this tissue in response to iron feeding, and the relatively high content of ferritin in this tissue lends significance to the hypothesis of its regulatory role in iron absorption. The following modification of the hypothesis of Hahn, *et al.* is suggested: Iron is assumed to be absorbed into the mucosal cells in the ferrous form (Fig. 1). Here it is stored in the form of ferritin, which is a combination of the protein apoferritin with ferric hydroxide (*1*). In the cell there is postulated to be an equilibrium between ferrous iron and the ferric iron stored in ferritin, the cell being in a state of "physiological saturation" with respect to ferrous iron. A lowering of the concentration of serum iron in the blood stream would lead to the removal of ferrous iron from the mucosal cell, resulting in a diminution of ferritin iron in the mucosa. Only when the ferritin iron had diminished to a point where the cell was no longer "physiologically saturated" with respect to ferrous iron would more iron be absorbed by the cell.

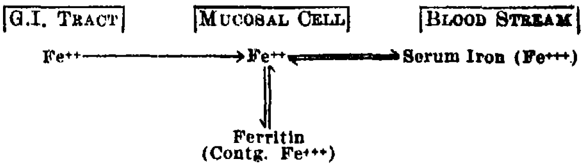


FIG. 1

The protein apoferritin crystals themselves (*i.e.* ferritin free from iron) could not be detected in the gastrointestinal tract, either in the normal or in the iron-fed animals. In response to iron feeding a great increase in ferritin was observed, which signifies a great increase in the protein apoferritin. Here, then, is the curious phenomenon: The feeding of iron leads to an increase in the concentration of a particular protein which combines with iron to form a storage compound for the iron.

Details of these experiments will be published later.

References

1. GRANICK, S., and MICHAELIS, L. *J. biol. Chem.*, 1943, 147, 91.
2. HAHN, P., BALE, W., ROSS, J., BALFOUR, W., and WHIPPLE, G. H. *J. exp. Med.*, 1943, 78, 169.
3. WIDDOWSON, E., and MCCANCE, R. *Biochem. J.*, 1937, 31, 2029.

---

[1] Gratitude is expressed to Dr. Leonor Michaelis for his interest and advice in this work.

The Use of Synthetic *L. Casei* Factor in the Treatment of Sprue[1,2]

William J. Darby, Edgar Jones, and
Howard C. Johnson
Vanderbilt University School of Medicine

Vitamin M deficiency in the monkey (*5*) and the sprue syndrome in man present similar clinical pictures. The demonstration by Day and co-workers (*3*) that vitamin M deficiency in the monkey is cured promptly by the injection of highly purified *L. casei* factor has led us to test the efficacy of synthetic *L. casei* factor (Lederle) (*1*)[3] in the treatment of sprue. Liver and liver extracts have long been known to be of value in the treatment of this latter disease.

Three patients with sprue have been admitted to the Medical Service of Vanderbilt University Hospital since 24 September 1945. These cases have fulfilled all of the criteria necessary for such a diagnosis: viz., glossitis; diarrhea with increased fat content of the stools; marked loss of weight; pigmentation of the skin; macrocytic anemia; moderate leucopenia; impairment of absorption as indicated by a flat oral glucose tolerance curve with a normal intravenous tolerance curve, a flat vitamin A tolerance curve, and a very low serum carotene content; and a characteristic gastrointestinal pattern on X-ray examination. Free hydrochloric acid was present in the gastric juice of each. Sternal marrow of two of the patients was examined and found to be typical of that seen in untreated sprue and pernicious anemia.

After a preliminary period of observation these patients received daily intramuscular injections of 15 mg. of synthetic *L. casei* factor[4] as the sole therapeutic agent. In all three cases there has occurred prompt hematological and clinical improvement. The symptoms of glossitis have disappeared within three or four days, followed by rapid regeneration of the lingual papillae; there has been an improved sense of well being; the diarrhea has subsided; the appetite has improved, and there has followed an impressive gain in weight. The first man so treated has gained 26 pounds within the six-week period since the institution of therapy.

Maximum reticulocyte responses of 15.3 per cent and 43 per cent occurred respectively in the first two cases on the eighth and sixth days of treatment. The third case has 11 per cent reticulocytes on the sixth day of therapy (time of writing), having had less than 1 per cent prior to treatment. These responses have been accompanied by a great increase in the number of platelets and a rise in the white cell counts. There have also been increases of both red blood cells and hemoglobin concentration. Examinations of aspirated sternal marrow after treatment have shown the disappearance of the more primitive red blood cells and a return of the white cell series to normal proportions.

The striking and rapid response of these three patients leads us to suggest that this synthetic factor is identical with, or very closely allied to, the substance in liver extract which is effective in the treatment of sprue. Furthermore, it seems probable that vitamin M deficiency in the monkey is the experimental analogue of sprue in man. Inasmuch as that factor which relieves macrocytic anemia of pregnancy is so closely related to vitamin M (*2, 7*), it is suggested that this synthetic material may prove efficacious in the treatment of patients with this macrocytic anemia of pregnancy. A possible relationship of this *L. casei* factor to the erythrocyte maturating factor is suggested by the great similarity of the blood picture, the marrow, and the glossitis in sprue and pernicious anemia.

Spies, *et al.* (*6*) have reported that this synthetic factor is effective in the treatment of incompletely diagnosed macrocytic anemia. Goldsmith (*4*) has reported the successful treatment of a case of "nutritional macrocytic anemia" with "folic acid."

References

1. Angier, R. B., *et al.* *Science*, 1945, **102**, 227–228.
2. Day, P. L. *Vit. Horm.*, 1944, **2**, 71.
3. Day, P. L., Mims, V., Totter, J. R., Stokstad, E. L. R., Hutchings, B. L., and Sloane, N. H. *J. biol. Chem.*, 1945, **157**, 423.
4. Goldsmith, G. A. Personal communication.
5. Langston, W. C., Darby, W. J., Shukers, C. F., and Day, P. L. *J. exp. Med.*, 1938, **68**, 923.
6. Spies, T. D., Vilter, C. F., Koch, M. B., and Caldwell, M. H. *S. med. J.*, 1945, **38**, 707.
7. Wills, L., and Stewart, A. *Brit. J. exp. Path.*, 1935, **16**, 444.

---

[1] Two of the cases discussed here were reported at the meeting of the Southern Medical Association, Cincinnati, 14 November 1945.

[2] A part of this study was supported by the Tennessee-Vanderbilt Nutrition Project, a cooperative undertaking of the International Health Division of the Rockefeller Foundation, the Nutrition Foundation, Inc., and the Tennessee Department of Public Health.

[3] We are indebted to Dr. Stanton M. Hardy, medical director of the Lederle Laboratories, Inc., for generous gifts of this synthetic *L. casei* factor.

[4] The crystalline material was dissolved in water by the addition of a minimal quantity of disodium phosphate, and the solution autoclaved at 10 pounds' pressure for 15 minutes.

Plan to attend 113th Meeting AAAS

St. Louis—27-30 March

News and Notes

Ralph Vinton Lyon Hartley, engineer of Bell Telephone Laboratories, has been presented the Institute of Radio Engineers Medal of Honor. The official citation reads: "For his early work on oscillating circuits employing triode tubes and likewise for his early recognition and clear exposition of the fundamental relationship between the total amount of information which may be transmitted over a transmission system of limited bandwidth and the time required." Dr. Peter C. Goldmark, engineer of the Columbia Broadcasting System, was the recipient of the Morris-Liebmann Memorial Prize, his citation reading: "For his contributions to the development of television systems, particularly in the field of color."

Omar C. Held, who has been commanding officer of the Naval units at Colgate University, has been appointed dean of the College of Letters and Science at St. Lawrence University, Canton, New York.

Dr. John D. Strong, physicist, will join the Johns Hopkins University staff in February as professor of physics, it has been announced by the president of the University.

L. E. Melchers, head of the Department of Botany and Plant Pathology, Kansas State College, was unable to accept a recent appointment to a position in the Egyptian Ministry of Agriculture, Cairo, Egypt, where he was to have acted in an advisory capacity for two years. Prof. Melchers served as chief mycologist for the Egyptian Government from 1927 to 1929.

Dr. H. R. Hulme has been appointed scientific adviser to the Air Ministry in London. He was previously chief assistant at the Royal Observatory, Greenwich.

Dr. William V. Houston, professor of physics at California Institute of Technology, Pasadena, California, has been elected president of Rice Institute and will take over his duties as of 1 March.

Dr. H. J. Muller, for the past five years at Amherst, joined the staff of the Department of Zoology, Indiana University, 1 July 1945. Recently he returned from England, where he delivered the Pilgrim Trust Lecture on "The Gene" before the Royal Society on 1 November. He gave the first two lectures of the Messenger series, on "Genetic Fundamentals," at Cornell University on 26 and 28 November.

The Rockefeller Institute for Medical Research announces the appointment of Dr. David P. C. Lloyd as associate member. Dr. Reginald M. Archibald has been appointed associate, and Dr. James A. Baker has been promoted from assistant to associate. Dr. Cynthia H. Pierce and Dr. James R. Weisiger have been appointed assistants.

Dr. Frank Glass Dunnington, Rutgers physicist who headed the group of scientists that developed modulator units at the Radiation Laboratory, Massachusetts Institute of Technology, has returned to active duty at Rutgers University. Dr. Robert C. Clothier, president, has also announced that Dr. Dunnington, who was an assistant professor of physics at the time of his departure early in 1941, has been promoted to associate professor and will become chairman of the Physics Department on the retirement this year of Dr. George Winchester, professor of physics and present department head.

Dr. J. Brian Eby, geologist, of Houston, Texas, has accepted a Distinguished Lectureship under the title of graduate professor of geology at Agricultural and Mechanical College of Texas for the spring semester, 1946, according to Frederick A. Burt, acting head of the Department. Dr. Eby will give special work in petroleum geology methods.

Dr. Henry Rudolf Henze, professor of pharmaceutical chemistry at the University of Texas, has been appointed 1946 Research Lecturer by the Graduate Faculty and the Board of Regents. He will be the fourth chemist out of 24 professors chosen for the honor of being Research Lecturer. Dr. Henze will give a series of three lectures in late April or May. Recently Dr. Henze was elected permanent chairman of the Texas Association for the Study of Social and Political Implications of Atomic Energy.

Dr. Bertrand E. Lowenstein, instructor in the Department of Physiology of Yale University School of Medicine, has joined the Division of Research at the Cleveland Clinic. He will carry on genitourinary investigations under the terms of the Packard Endowment gift.

W. T. Ayer, of the Engineering Department of the Hercules Powder Company in Wilmington, has retired after 27 years of service.

Announcements

The American Anthropological Association, at its forty-fourth annual meeting, held at the University Museum, Philadelphia, on 28 December, elected Dr. Ralph Linton, Columbia University, to the presidency

The Use of Synthetic *L. Casei* Factor in the Treatment of Sprue[1,2]

William J. Darby, Edgar Jones, and
Howard C. Johnson
Vanderbilt University School of Medicine

Vitamin M deficiency in the monkey (*5*) and the sprue syndrome in man present similar clinical pictures. The demonstration by Day and co-workers (*3*) that vitamin M deficiency in the monkey is cured promptly by the injection of highly purified *L. casei* factor has led us to test the efficacy of synthetic *L. casei* factor (Lederle) (*1*)[3] in the treatment of sprue. Liver and liver extracts have long been known to be of value in the treatment of this latter disease.

Three patients with sprue have been admitted to the Medical Service of Vanderbilt University Hospital since 24 September 1945. These cases have fulfilled all of the criteria necessary for such a diagnosis: viz., glossitis; diarrhea with increased fat content of the stools; marked loss of weight; pigmentation of the skin; macrocytic anemia; moderate leucopenia; impairment of absorption as indicated by a flat oral glucose tolerance curve with a normal intravenous tolerance curve, a flat vitamin A tolerance curve, and a very low serum carotene content; and a characteristic gastrointestinal pattern on X-ray examination. Free hydrochloric acid was present in the gastric juice of each. Sternal marrow of two of the patients was examined and found to be typical of that seen in untreated sprue and pernicious anemia.

After a preliminary period of observation these patients received daily intramuscular injections of 15 mg. of synthetic *L. casei* factor[4] as the sole therapeutic agent. In all three cases there has occurred prompt hematological and clinical improvement. The symptoms of glossitis have disappeared within three or four days, followed by rapid regeneration of the lingual papillae; there has been an improved sense of well being; the diarrhea has subsided; the appetite has improved, and there has followed an impressive gain in weight. The first man so treated has gained 26 pounds within the six-week period since the institution of therapy.

Maximum reticulocyte responses of 15.3 per cent and 43 per cent occurred respectively in the first two cases on the eighth and sixth days of treatment. The third case has 11 per cent reticulocytes on the sixth day of therapy (time of writing), having had less than 1 per cent prior to treatment. These responses have been accompanied by a great increase in the number of platelets and a rise in the white cell counts. There have also been increases of both red blood cells and hemoglobin concentration. Examinations of aspirated sternal marrow after treatment have shown the disappearance of the more primitive red blood cells and a return of the white cell series to normal proportions.

The striking and rapid response of these three patients leads us to suggest that this synthetic factor is identical with, or very closely allied to, the substance in liver extract which is effective in the treatment of sprue. Furthermore, it seems probable that vitamin M deficiency in the monkey is the experimental analogue of sprue in man. Inasmuch as that factor which relieves macrocytic anemia of pregnancy is so closely related to vitamin M (*2*, *7*), it is suggested that this synthetic material may prove efficacious in the treatment of patients with this macrocytic anemia of pregnancy. A possible relationship of this *L. casei* factor to the erythrocyte maturating factor is suggested by the great similarity of the blood picture, the marrow, and the glossitis in sprue and pernicious anemia.

Spies, *et al.* (*6*) have reported that this synthetic factor is effective in the treatment of incompletely diagnosed macrocytic anemia. Goldsmith (*4*) has reported the successful treatment of a case of "nutritional macrocytic anemia" with "folic acid."

References

1. Angier, R. B., *et al.* *Science*, 1945, **102**, 227-228.
2. Day, P. L. *Vit. Horm.*, 1944, **2**, 71.
3. Day, P. L., Mims, V., Totter, J. R., Stokstad, E. L. R., Hutchings, B. L., and Sloane, N. H. *J. biol. Chem.*, 1945, **157**, 423.
4. Goldsmith, G. A. Personal communication.
5. Langston, W. C., Darby, W. J., Shukers, C. F., and Day, P. L. *J. exp. Med.*, 1938, **68**, 923.
6. Spies, T. D., Vilter, C. F., Koch, M. B., and Caldwell, M. H. *S. med. J.*, 1945, **38**, 707.
7. Wills, L., and Stewart, A. *Brit. J. exp. Path.*, 1935, **16**, 444.

---

[1] Two of the cases discussed here were reported at the meeting of the Southern Medical Association, Cincinnati, 14 November 1945.

[2] A part of this study was supported by the Tennessee-Vanderbilt Nutrition Project, a cooperative undertaking of the International Health Division of the Rockefeller Foundation, the Nutrition Foundation, Inc., and the Tennessee Department of Public Health.

[3] We are indebted to Dr. Stanton M. Hardy, medical director of the Lederle Laboratories, Inc., for generous gifts of this synthetic *L. casei* factor.

[4] The crystalline material was dissolved in water by the addition of a minimal quantity of disodium phosphate, and the solution autoclaved at 10 pounds' pressure for 15 minutes.

Plan to attend 113th Meeting AAAS

St. Louis—27-30 March

News and Notes

Ralph Vinton Lyon Hartley, engineer of Bell Telephone Laboratories, has been presented the Institute of Radio Engineers Medal of Honor. The official citation reads: "For his early work on oscillating circuits employing triode tubes and likewise for his early recognition and clear exposition of the fundamental relationship between the total amount of information which may be transmitted over a transmission system of limited bandwidth and the time required." Dr. Peter C. Goldmark, engineer of the Columbia Broadcasting System, was the recipient of the Morris-Liebmann Memorial Prize, his citation reading: "For his contributions to the development of television systems, particularly in the field of color."

Omar C. Held, who has been commanding officer of the Naval units at Colgate University, has been appointed dean of the College of Letters and Science at St. Lawrence University, Canton, New York.

Dr. John D. Strong, physicist, will join the Johns Hopkins University staff in February as professor of physics, it has been announced by the president of the University.

L. E. Melchers, head of the Department of Botany and Plant Pathology, Kansas State College, was unable to accept a recent appointment to a position in the Egyptian Ministry of Agriculture, Cairo, Egypt, where he was to have acted in an advisory capacity for two years. Prof. Melchers served as chief mycologist for the Egyptian Government from 1927 to 1929.

Dr. H. R. Hulme has been appointed scientific adviser to the Air Ministry in London. He was previously chief assistant at the Royal Observatory, Greenwich.

Dr. William V. Houston, professor of physics at California Institute of Technology, Pasadena, California, has been elected president of Rice Institute and will take over his duties as of 1 March.

Dr. H. J. Muller, for the past five years at Amherst, joined the staff of the Department of Zoology, Indiana University, 1 July 1945. Recently he returned from England, where he delivered the Pilgrim Trust Lecture on "The Gene" before the Royal Society on 1 November. He gave the first two lectures of the Messenger series, on "Genetic Fundamentals," at Cornell University on 26 and 28 November.

The Rockefeller Institute for Medical Research announces the appointment of Dr. David P. C. Lloyd as associate member. Dr. Reginald M. Archibald has been appointed associate, and Dr. James A. Baker has been promoted from assistant to associate. Dr. Cynthia H. Pierce and Dr. James R. Weisiger have been appointed assistants.

Dr. Frank Glass Dunnington, Rutgers physicist who headed the group of scientists that developed modulator units at the Radiation Laboratory, Massachusetts Institute of Technology, has returned to active duty at Rutgers University. Dr. Robert C. Clothier, president, has also announced that Dr. Dunnington, who was an assistant professor of physics at the time of his departure early in 1941, has been promoted to associate professor and will become chairman of the Physics Department on the retirement this year of Dr. George Winchester, professor of physics and present department head.

Dr. J. Brian Eby, geologist, of Houston, Texas, has accepted a Distinguished Lectureship under the title of graduate professor of geology at Agricultural and Mechanical College of Texas for the spring semester, 1946, according to Frederick A. Burt, acting head of the Department. Dr. Eby will give special work in petroleum geology methods.

Dr. Henry Rudolf Henze, professor of pharmaceutical chemistry at the University of Texas, has been appointed 1946 Research Lecturer by the Graduate Faculty and the Board of Regents. He will be the fourth chemist out of 24 professors chosen for the honor of being Research Lecturer. Dr. Henze will give a series of three lectures in late April or May. Recently Dr. Henze was elected permanent chairman of the Texas Association for the Study of Social and Political Implications of Atomic Energy.

Dr. Bertrand E. Lowenstein, instructor in the Department of Physiology of Yale University School of Medicine, has joined the Division of Research at the Cleveland Clinic. He will carry on genitourinary investigations under the terms of the Packard Endowment gift.

W. T. Ayer, of the Engineering Department of the Hercules Powder Company in Wilmington, has retired after 27 years of service.

Announcements

The American Anthropological Association, at its forty-fourth annual meeting, held at the University Museum, Philadelphia, on 28 December, elected Dr. Ralph Linton, Columbia University, to the presidency of the Association. Dr. Linton succeeds Dr. Neil M. Judd, curator of archeology, U. S. National Museum.

Recommending an international control organization to guard the atomic bomb, Frederic Joliot-Curie urged establishment of a security council with a consultative committee to discuss opinions of all specialists. Under the auspices of the Nationalist Union, Mr. Joliot-Curie spoke at the Sorbonne on the question of atomic energy before an audience of some eight thousand persons during the third week in November. Referring to the secrecy surrounding American research on the atomic bomb, to the fact that American laboratories were closed to foreign scientists and that relations with scholars of this nation have been interrupted, he emphasized the gravity of this blow to international solidarity. Such secrecy, he argued, is likely to hinder man's progress in the study of the practical application of atomic disintegration for the improvement of civilization. He added that scientists of the United States, aware of this, are protesting in official quarters in an effort to show the disastrous consequences which may come out of the laboratory. Frederic Joliot-Curie, with his wife, Irene Joliot-Curie, son-in-law and daughter of Pierre and Marie Curie, have continued the latter's research on artificial radioactivity and uranium fission.

After the war's outbreak, the French Government asked them and their colleagues, Halban and Kowarski, to concentrate their efforts upon the discovery of an atomic explosive. However, France's military collapse in 1940 made it impossible for them to go on with this work. According to the French Press and Information Service, their "secret discoveries and the stores of heavy water which they had obtained from Norway were smuggled out of the country and into the hands of those scientists who were still free to work on the project."

A cable to *The New York Times* dated 4 January carried the news that Frederic Joliot-Curie, Irene Joliot-Curie, Pierre Auger, and Francois Perrin, the latter two of the Sorbonne faculty, have been appointed to a French scientific committee which will organize and coordinate methods of utilizing atomic power for peace and national defense. Raoul Dautry, Minister of Reconstruction, has been named the administrator of the committee.

Officers of the Southwestern Philosophical Conference for 1946 are H. N. Lee, president; A. J. Bahm, vice-president; L. E. Hahn, secretary-treasurer; and Gustav Mueller, I. K. Stephens, and W. B. Mahan, Executive Committee members.

The first Edgar Allen Memorial Lecture was delivered on 3 December 1945 by Dr. H. B. Andervont, senior biologist of the National Cancer Institute, under the auspices of the Atypical Growth Research Unit, of the Yale University School of Medicine. The subject of his lecture was: "The Mammary Tumor Agent and Its Implications in Cancer Research."

The Board of Governors of the Institute of Medicine of Chicago, at its annual meeting on 12 December, elected the following officers for the coming year: Dr. William F. Petersen, chairman of the Board; Dr. Ernest E. Irens, president; Dr. Percival Bailey, vice-president; Dr. George H. Coleman, secretary; Dr. Grant H. Laing, treasurer. Dr. Italo F. Volini was elected a member of the Board for a term of five years. At the thirtieth annual meeting of the Institute on Tuesday, 4 December, Mrs. Harry Hart, long actively engaged in health and child welfare services in Chicago, Miss Mary E. Murphy, the director of the Elizabeth McCormick Memorial Fund, and Mr. Wilfred S. Reynolds, the director of the Council of Social Agencies of Chicago, were received into citizen fellowship. Citizen fellowship is conferred by unanimous vote of the Board of Governors on persons who are interested in, and who have materially contributed to, the welfare of the community in the field of medicine, dentistry, nursing, public health, social service, or instruction, and not more than three candidates can be elected in any one year.

President Conant of Harvard has announced the reorganization of the Harvard School of Public Health. Brig. Gen. James S. Simmons, chief of the preventive medicine service of the Office of the Surgeon General, has been appointed dean of the school, and the Rockefeller Foundation has granted $1,000,000 for expenses from 1 July 1946 to 30 June 1956. Harvard has set aside an additional $750,000 as an endowment to supplement the present endowment fund. The school will have equal status with the Medical School and other professional divisions of the university. Gen. Simmons is expected to assume his new duties on 1 July. He received the Distinguished Service Medal in November for exceptionally meritorious service which included responsibility for the health of troops, civilians engaged in war work, refugees and displaced persons throughout the world.

Osteopathic physicians and surgeons of the Commonwealth of Pennsylvania may be named medical examiners in connection with the State's new school health law requiring physical examination of all pupils and teachers, the Justice Department ruled recently. The health law provided that medical examiners be physicians "legally qualified to practice medicine in the Commonwealth." Attorney General

James H. Duff held that previous rulings had held osteopathic physicians were eligible to serve as school medical inspectors under a law enacted in 1911. The opinion also reviewed debate in the 1945 session of the Legislature in which the section in question was changed from "doctor of medicine" to "physicians" with the understanding that the change was aimed at eliminating any discrimination against osteopathic physicians and surgeons.

Dr. Charles Lathrop Parsons, secretary of the American Chemical Society since 1907, and its business manager since 1931, retired 31 December from both offices. Dr. Parsons, 78, one of the most widely known members of the American Chemical profession, will continue to serve the Society, having recently been elected to the board of directors for 1946.

Meetings

The New England Association of Chemistry Teachers will hold its Eighth Summer Conference at Middlebury College, Middlebury, Vermont, on 19–24 August 1946.

The American Society for Metals is sponsoring three round-table discussions during the National Metal Congress and Exposition to be held in Cleveland's Public Hall the week of 4 February. The first meeting, on Monday evening, will discuss the general subject of the transformation of austenite either at constant temperature or during quenching, and its related problems. On Tuesday night the discussion will center on the super-alloys for high-temperature service in gas turbines and jet engines. On Wednesday evening the discussion on atomic energy and its implications will be high-lighted by talks from men who played notable parts in the development of the atomic bomb.

The American Society of Mechanical Engineers has announced a resumption of its full schedule of national and regional meetings, which were interrupted by the war. The Spring Meeting, first of the national gatherings, will be held in Chattanooga, Tennessee, 1–3 April, at the Hotel Patten and Reid House. The regional Aviation Meeting, sponsored by the pioneer Aviation Division of the ASME, will again be held at the University of California in Los Angeles, 3–6 June. Detroit has been selected for the Semiannual Meeting on 17–20 June, with headquarters at Hotel Statler. The Fall Meeting will be held in Boston, at the Statler, 30 September and 1–2 October. The Annual Meeting, always held in New York, will open at the Hotel Pennsylvania on 2 December and continue through 6 December.

Conditions Abroad

Fred Vles, 59, of the Sorbonne and Biological Station of Roscoff, died during deportation to Germany near the beginning of July 1944.

Dr. Chu-Chia Wang writes that he suffered complete loss of his personal effects and professional equipment during the war, as well as heavy family losses. He is now on the staff of the Department of Botany, University of Shanghai, but because of lack of equipment and literature, together with a very heavy teaching load, is unable as yet to return to his research on the fresh-water algae of China.

Mme. Lucienne Gauthier-Lièvre, Laboratoire de Botanique, Université d'Alger, writes that she is about to leave Algiers for a botanical excursion to the Côte d'Ivoire, Soudan and Niger, from which she does not expect to return before May. Mme. Gauthier-Lièvre is well known for her extensive publications on the fresh-water algae of North Africa.

Dr. Léon Delarge, Institut Botanique, Université de Liége, Adjudant de Réserve, was mortally wounded at Aerseele sur la Lys on 27 May 1940. Dr. Delarge had established himself as an experimental morphologist before the war; his extensive unpublished researches on the growth of isolated roots *in vitro* were issued posthumously (*Mem. Soc. roy. Sci. Liége*, 1941, **V**, ii) and in a special volume with a biography (1941) under the supervision of Prof. R. Bouillenne.

Dr. Leiv Kreyberg, of the University Institute of Pathology, Oslo, has written to Dr. Mildred Schram, secretary of the International Cancer Research Foundation, Philadelphia, that he has been in military service for more than five years and has now returned to the Institute, which lacks textbooks, dyes, cover glasses, etc.

Recent Deaths

Austen Mansfield Curtis, 55, the engineer who at a listening post in the Eiffel Tower in Paris received the first spoken words transmitted across the Atlantic by radio telephone in 1915, died on 22 December 1945 at South Orange, New Jersey.

Dr. Edward F. Kern, 73, retired professor of metallurgy and electrometallurgy at the School of Mines of Columbia University, died at his home in Argyle, New York, on 5 January 1946.

Prof. Parke Benjamin Fraim, 59, physicist and member of the faculty of Brooklyn Polytechnic Institute for twenty-four years, died of a heart attack at his home in Brooklyn on 13 January.

In the Laboratory

A Superior Pith for Free-hand Sections

FERNANDO CARVAJAL
Lawrenceburg, Indiana

The dry pith of mature stalks of the rice-paper tree, *Tetrapanax papyriferum* Koch, has proved superior to commercial pith (elder) for use in the free-hand sectioning of plant material by the writer for a period of years.

This pith is white, devoid of vascular bundles or other hard tissues, and of uniform texture. The plant is in cultivation largely as an ornamental in the southern United States and was first used by the writer at Louisiana State University, where he found it growing on the campus. The pith is extractable from the dead stalks during the winter in straight rods 1.5 cm. in diameter and up to a meter or more in length, the pith being usually continuous and uniform through the nodes.

Under the binocular microscope (wide field, long working distance) it has been found possible to cut satisfactory sections of such fragile materials as leaves, stems, and roots of healthy or diseased plants. For example, this pith has been used to section leaf lesions with fruiting bodies of fungi, galls bearing the so-called X-bodies of a virus (Fiji disease of sugar cane causing galls on leaves), and tobacco stems and leaves affected with the bacteria, *Phytomonas solanacearum.* It has also been used to section roots of plants affected by fungi, bacteria, nematodes, etc., such as roots of sugar cane affected by the fungus, *Pythium arrhenomanes.* It has proved equally successful in working with fresh material from the field, dry, preserved material, or specimens which have been kept in fixing solutions.

Double-edged blades are very helpful for the sectioning. A small piece of material to be sectioned is placed in the pith and held by a clamp which is open at the top (Hoffman Screw Compressor type). The sectioning is done under the binocular microscope. For best results, the sections are made in dry pith and then fixed as soon as they are cut. By means of a needle (wetting the tip of the needle first), the sections are transferred from the pith or blade to a drop of water or stain solution on a glass slide or to the fixing solution. Direct transfers to a drop of lactophenol, with or without cotton blue, and then gently warming the slide gave good results.

This technique was used by the writer in the studies of host-parasite relationships, anatomical and physiological studies of the red rot disease of sugar cane *(1)*, and others.

Reference

1. CARVAJAL, FERNANDO, and EDGERTON, C. W. *Phytopathology*, 1944, **34**, 206–213, 827–837.

A Culture Method for Certain Marine Algae[1,2]

J. C. STRICKLAND
Virginia Fisheries Laboratory, Yorktown

There is an abundant literature describing the media and procedures for developing unialgal cultures of various marine phytoplankton organisms. Most of these methods demand considerable time as well as specialized equipment or technic. To facilitate studies of the dietary requirements of the larval blue crab, a simple and speedy method was needed for establishing and maintaining unialgal cultures of several plankton organisms at our station on the York River. In meeting a somewhat similar problem, Loosanoff and Engle (*Science*, 1942, **95**, 487–488) found that complete fertilizers[3] of the formulae 5-3-5 or 6-3-6 in solutions of 1 gram of fertilizer to each 1,000 cc. of water provided effective media for growing plankton. Tests of this method favored it for our purpose, but there were two limitations: (1) the undissolved residue obscured early indications of growth and was objectionable to the feeding larvae, and (2) there was an excessive formation of bacterial gloea which inhibited or rendered feeding difficult. The following report describes a logical modification in the preparation of this medium for laboratory use and a simple dilution method used for establishing unialgal cultures.

The usual precautions are taken in cleaning glassware. The water used for rinsing and in the preparation of culture solution is previously filtered through a thick layer of nonabsorbent cotton to remove any larger organisms, silt, or detritus present.

To a flask containing 1,000 cc. of filtered water is added 0.5 to 1.0 gram of pulverized 5-3-5 or 6-3-6 fertilizer and, with frequent shaking, the mixture is brought to a slow boil over a low flame. After several minutes it is set aside and the medium allowed

---

[1] Joint contribution of the Virginia Fisheries Laboratory (Number 24) and the Department of Biology of the College of William and Mary.

[2] The author is indebted to Dr. V. L. Loosanoff for the supply of fertilizer used and for much valuable information and advice.

[3] Manufactured by the American Agricultural Chemical Company, 50 Church Street, New York City.

to cool at room temperature. When it is cool enough to handle comfortably, the decoction is filtered through nonabsorbent cotton into Erlenmeyer flasks to a depth of about one centimeter. The flasks are plugged with cotton and set aside for 24 hours to permit the solution to cool and become sufficiently aerated.

Plankton is taken at the desired habitat, and inoculations are made as soon as possible by merely shaking the plankton mixture and pouring a small portion of it into the nutrient solution. These gross cultures are exposed to north light at room temperature and allowed to develop for 2 weeks. A microscopic examination will now reveal the organisms which may be most easily isolated and grown. The gross culture is shaken vigorously, portions being poured into watch glasses and, while viewed under a dissecting microscope, diluted to a point providing a satisfactory dispersal of the material. A fine pipette is used to withdraw several of the desired individuals, which are placed in fresh nutrient solution. The inoculated cultures are shaken and exposed to strong illumination from Mazda fluorescent 25-watt lights (each sufficient for 20 to 25 cultures) for about 12 to 14 hours daily. After a week, the cultures are inspected each day for signs of development. When such is detected, a few organisms are removed with a capillary pipette and transferred to fresh media. After three or four subcultures are made in this way, development is allowed to become more extensive until a suitable amount of material can be withdrawn for a thorough microscopic examination. Some cultures will be found to be unialgal at this stage, while others must be subcultured further until they are satisfactory. Vigorous shaking of the culture after inoculation, as well as use of small portions for inoculation, will yield the best results.

The use of artificial illumination materially speeds growth and shortens the time between each subculturing by 5 or 6 days. Unialgal cultures established in this nutrient were subcultured every 60 days. This was done by merely shaking the culture and pouring a small portion into a flask of fresh medium. Uninoculated media may be stored in an icebox for several days without appreciable change.

The combination of this medium and method of culture is suggested as being potentially useful in many ways, such as maintaining organisms for feeding or life-history study, providing large populations of otherwise scattered forms, growing soil algae, or furnishing a constant source of material for teaching purposes.

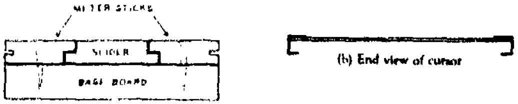
Pennate diatoms, especially *Nitzschia* and *Navicula* spp., were found to be particularly adaptable to this culture medium. The centric diatoms, *Coscinodiscus*, *Chaetoceras*, *Melosira* spp., did not develop so well, and the dinoflagellates, *Ceratium* and *Glenodinium* spp., did not grow at all. It may be noted also that various forms of marine or brackish Myxophyceae, such as *Spirulina subsalsa* and *Lyngbya semiplena*, grow luxuriantly.

A Slide Rule for the Addition of Squares

William E. Morrell
University of Illinois

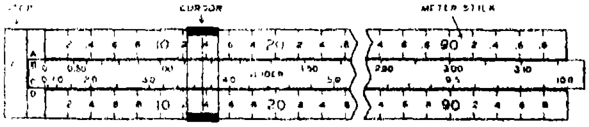
Some years ago the writer had occasion to solve several thousand problems of the type: $d = (x^2 + y^2 + z^2)^{\frac{1}{2}}$. For the purpose a slide rule with appropriate square and square-root scales was constructed. Its convenience, demonstrated in continued use, leads him to believe that it might be found helpful to others in the solution of problems involving square roots and squares and the addition and subtraction of the latter. Such problems are often encountered in, for example, geometry and trigonometry (*cf.*: $2bc \cos A = b^2 + c^2 - a^2$).

The fixed part of the rule consists of two meter sticks, grooved as shown in diagram (a), and screwed to a baseboard. A hardwood slider about 103 cm. long is grooved to fit between the meter sticks. The cursor (diagram (b)) consists of a piece of glass mounted with Duco cement between two pieces of metal, fitted so as to slide in slits in the edges of the meter sticks. A hair line is scratched on the under side of the glass. About 1.5 cm. to the left of the zero end of the meter sticks a "stop" (see diagram (c)) is screwed to the baseboard.



(a) End view of slide rule

(b) End view of cursor



(c) Assembled rule (scales simplified)

FIG. 1

Decimals added to the numbers on one of the meter sticks give A (diagram (c)) a scale which is linear from 0.0 to 10.0. The D scale, on the other meter stick, is linear from 0 to 100.

The corresponding square-root scales B and C on the slider are from 0.00 to 3.16 and from 0.0 to 10.0, respectively, as indicated in diagram (c). These scales were marked off with the slider firmly clamped in the null position, its left end being *against* the stop. Sharp graduation lines in the desired positions were cut with a razor blade. Carbon black was worked into the cuts to make the lines stand out clearly. The surface was then sanded clean, the numbers were written on with India ink, and the surface was varnished.

A little practice enables the more accurate scale for the problem at hand to be chosen quickly. With the slider in the null position, squares and square roots can be read from the rule directly. Square roots of numbers from 1 to 10, from 100 to 1,000, from 0.01 to 0.10, etc., would ordinarily be sought on the upper half of the rule, while square roots of numbers from 10 to 100, from 1,000 to 10,000, from 0.10 to 1.00, from 0.0010 to 0.0100, etc., would be sought on the lower half, keeping in mind any necessary shifts of decimal points.

Similarly, in problems involving sums of squares the upper half would be used for sums approaching 0.10, 10, 1,000, etc., and the lower half for sums approaching 0.01, 1, 100, 10,000, etc.

To solve for x in the problem: $x = (1.53^2 + 0.95^2 + 2.17^2)^{\frac{1}{2}}$, one can proceed as follows: With the slider in the null position (pushed against the stop), the cursor is set on 1.53 on the B scale. (The reading on the A scale is now 2.34.) The slider is then moved so that its 0.00 is under the hair line on the cursor. The cursor is then moved to 0.95 on the B scale. (The A scale reading, the sum of the two squares, is now 3.24.) Again the slider is moved so that its 0.00 is under the hair line. The cursor is next moved to 2.17 on the B scale. (The A scale reading, the sum of the three squares, is now 7.95.) Finally the slider is pushed back to the null position, and the reading on the B scale, the square root of the sum of the squares, is seen to be 2.82.

Except for the final push to the automatically set null position, the sequence of movements in the solution of this problem therefore is exactly analogous to the series of motions involved in solving the corresponding problem: $X = 1.53 \times 0.95 \times 2.17$ on an ordinary slide rule.

With this rule the final answer in problems of the type just discussed can be recorded to three significant figures, with the error seldom larger than one unit in the third figure. In the majority of cases there is no error in the third figure. In fact, on some portions of the rule (particularly the right-hand end of the B scale) the answer can be read to four significant figures with less error in the result than would occur, on the average, in rounding off four-figure calculating machine answers to three figures.

An ordinary slide rule adds logs. This one adds squares. Obviously, similar rules could be designed and constructed for the addition (and subtraction) of other functions, such as cubes, roots, trigonometric functions, etc., or even for combinations of these, merely by providing the desired scales on the slider. The width of the slider could be increased to allow for as many scales as one might want to place on it. If it were desired to have slide rules available for several types of problems, in some cases appropriate interchangeable sliders could be constructed for use in a single base. In many cases meter sticks could be used for the linear scales on home-made rules.

A simple experimental model of any rule can easily be made by marking off appropriate scales on pieces of paper or cardboard, which can be folded and fitted together to serve as slider and fixed part.

Thanks should be expressed to Dr. O. L. I. Brown, now of the United States Naval Academy, for suggestions which he made concerning the construction of the rule discussed above.

An Impurity in Some Commercial Penicillin Preparations Which Interferes With the Diazo Reaction in Determining Blood Phenols

JOHN C. HARTNETT
College of Medicine, University of Vermont

While determining the free phenol content of the blood of a uremic patient, using the method of Schmidt (*1*), the following was observed: After extracting 35 ml. of the Folin-Wu protein-free filtrate plus 1 ml. of 10 N sulfuric acid for 2 hours with absolute ether, the free phenol was determined in 3 ml. of the ether extract, to which had been added 5 ml. of 95-per cent ethyl alcohol, 2 ml. of water, 1 ml. of diazotized *p*-nitroaniline reagent, and 3 ml. of 5-per cent sodium carbonate. The normal reaction yields a clear, straw-yellow to orange color. However, on this particular determination the final color which developed was an olive green, which, of course, made a colorimetric comparison impossible. This result was obtained with each of two blood samples taken on consecutive days.

Upon investigation it was found that 48 hours previous to securing the first blood sample the patient had received intravenously 220,000 Oxford Units of the sodium salt of penicillin (Brand I). The patient was anuric (except for one catheterized specimen) up to the time the blood sample was taken. It was hypothesized that the penicillin in the blood might be the cause of the adverse reaction, bearing in mind that penicillin is normally excreted in from 2 to 4 hours.

In an effort to gain information as to the source of the green color the following procedure was carried out:

To 2 ml. of water containing 5 mg. of penicillin (Brand II) was added 5 ml. of 95-per cent ethyl alcohol, 3 ml. of absolute ether, 1 ml. of diazotized *p*-nitroaniline reagent, and 3 ml. of 5-per cent sodium carbonate. The resulting color was of the same olive green as was seen in the above determinations. Two drops of concentrated hydrochloric acid, when added to this mixture, caused the olive green to fade and a brownish-yellow to appear. Upon realkalinizing, the olive green reappeared. It was also found in the above procedure that the color (olive green) formation required the presence of the 95-per cent ethyl alcohol, but did not require the absolute ether. A water solution of penicillin (Brand II), treated without the alcohol, gave a yellow-orange color upon diazotization.

The foregoing procedure was carried out on several other standard commercial penicillin preparations used clinically. In all cases the results were the same. However, a sample of pure crystalline penicillin sodium G and of "pure" penicillin sodium[1] did not give the slightest adverse chromogenic reaction, but did give a yellowish color with the diazotized *p*-nitroaniline reagent.

It was observed that a few of the yellow crystals (pure penicillin is colorless) of the standard preparations, when shaken with absolute ether, failed to dissolve. However, when a 35-ml. water solution of penicillin (Brand II) plus 1 ml. of 10 N sulfuric acid was extracted for 2 hours in the usual manner as for the determination of phenols, the ether extract, when treated with the diazo reagent, alcoholized, and then alkalinized, gave the olive green color. The ether extract itself had a yellow tinge, while the extracted water solution, which had been pale yellow, had lost its color.

From the evidence presented we may conclude that (a) those commercial preparations of penicillin tested contain some substance (or substances) which gives an adverse chromogenic reaction in the alcoholized, alkalinized, diazotized medium used in determining free phenols according to Schmidt; (b) it is probable that the yellow color in the penicillin preparations is responsible; and (c) pure penicillin G (sodium salt), when alcoholized, alkalinized, and diazotized, does not give the adverse chromogenic reaction, but does give a yellow to orange diazo reaction.

Reference

1. Schmidt, E. G. *J. biol. Chem.*, 150, 69–73.

---

[1] Kindly supplied by Merck & Company, Inc., Rahway, New Jersey.

A Method of Growing Dense Cultures of *Paramecium*

John Stanley
Queen's University, Kingston, Ontario

The method described below will produce very dense cultures of *Paramecium* substantially free from other *Protozoa* other than minute forms which do not interfere with the use of the material for class purposes. Variations in the method have been tried, but none has given as good results.

Obtain a glass jar about 7 in. deep by a 4- or 5-in. internal diameter. Place in this a tripod made of glass rod or tubing, with its top about 1½ in. below the top of the jar. The tripod consists simply of a ring of tubing a little smaller than the jar, with three legs fused to it.

Pick off the grass blades from some hay, lay them parallel, and cut to length, so as to make a mattress of them, resting on the glass tripod. The mattress should be about ¾ in. thick when pressed down a little.

Fill the jar with tap water to such a depth that the grass mattress is just awash at the top, and then place the jar against the side of an embedding oven set to about 50° C. (The jar is outside the oven, in the room.) With normal room temperatures, this should result in a temperature gradient across the jar, varying from about 25° C. near the oven to about 23° C. away from the oven. Place a lid on the jar and leave for a few days until a thin, whitish scum commences to form on top. Inoculate with *Paramecium,* and leave for another 5 or 10 days, examining from time to time to see that the grass keeps just at or below the water surface. Add a little distilled water if necessary. At the end of this time, a heavy, whitish pellicle should have formed, with enormous numbers of *Paramecium* hiding just at the junction of pellicle and jar at some point at which the temperature suits them. Best results are obtained when the cool side of the jar faces the window, but is shaded from sunlight.

After a week or two, "lagoons" or clear spaces about ¼ in. in diameter will appear in the pellicle. If they do not do so, they should be made by cutting the pellicle from the glass all round. These lagoons are ringed with a whitish "fuzz" consisting of vast numbers of *Paramecium* in almost pure culture. The water below the tripod will be murky with bacteria and minute ciliates, which would seem to provide a reservoir of food for the *Paramecium.*

The culture will remain rich for some weeks and then fall off rapidly. If a new one is started every three weeks, a continuous supply of *Paramecium* for classes of many hundreds can be maintained.

For success it has seemed essential to (1) keep the grass mattress just awash and the grass about ¼ in. from the jar where the *Paramecium* grow best; (2) maintain a temperature gradient roughly between 23° and 25° C.; (3) use tap water free from injurious metals to start, and distilled water for later additions; (4) keep the jar covered with a loose lid; (5) try to encourage lagoon formation; (6) keep the grass blades at right angles to the temperature gradient, which should be in the direction of the incident light; and (7) shade from sunlight or really bright daylight.

Letters to the Editor

Convulsive Effects of Antibiotic Agents on the Cerebral Cortex

The lack of clinical evidence of neural toxicity when penicillin is administered systemically or intrathecally has led to the assumption that penicillin has no adverse effect upon the physiologic processes of the nervous system. The singular dearth of experimental studies of the effects of antibiotic substances applied to the brain has perpetuated this erroneous impression.

Both clinical and experimental studies on animals and man indicate that penicillin may produce convulsive manifestations when applied to the cerebrum. During systemic administration for conditions other than primary ones of the central nervous system, the electroencephalogram was found to be abnormal in more than 60 per cent of a series of 51 cases. Control records before and after penicillin therapy usually showed normal tracings. Large doses of penicillin injected intrathecally in man (40,000 units) or monkey (10,000 units) may give rise to generalized convulsions followed in some cases by coma and death. The application of as little as 250 units of penicillin to the cerebral cortex of the macaque may induce epileptic attacks. These convulsive phenomena are not due to impurities in the preparation, for they have occurred with penicillin made by ten different manufacturers and with purified crystalline penicillin.

Streptomycin applied to the cerebral cortices of cats and monkeys in doses of 1,250 units induced convulsive manifestations in 30 per cent of the cases. Electroencephalographic records at such times showed slow waves and spikes with subsequent decrease of cortical activity lasting for one to three hours. Cisternal injection of 2,500 units of streptomycin in the monkey induced signs of severe cerebellar dysfunction.

Streptothricin applied to the parietal cerebral cortex in doses of 5,000 to 10,000 units produced clinical and electroencephalographic convulsive manifestations. Although these phenomena usually disappeared spontaneously in two to three hours, in two monkeys they persisted for two weeks. At necropsy the brains of these animals showed extensive softenings with perivascular petechial hemorrhages.

Actinomycin injected into the cerebral cortex or cisterna magna in a dose of 1 mg., after a latent period of nine hours produced severe prostration, fasciculations, and convulsions with death in one to seven days. At the site of injection into the cerebral cortex a severe necrobiotic reaction with edema and petechial hemorrhages was found.

Clavacin, when injected into the cerebral cortex in doses of 5 to 10 mg., induced clinical and electroencephalographic manifestations of convulsive phenomena with a marked decrease in spontaneous electrical activity of the brain.

There appears to be a relatively wide margin of safety between the antibiotic concentration and convulsive threshold of penicillin and streptomycin. Such does not appear to be the case for streptothricin, clavacin, or actinomycin.

A. Earl Walker, Herbert C.
Johnson, Theodore J. Case,
and Jerry J. Kolleros
University Clinics, University of Chicago

The Genus *Aspergillus*

In his review of Thom and Raper's *Manual of the Aspergilli* (*Science*, 1945, 102, 460–461) Dr. B. O. Dodge says: "It is gratifying to see that the authors have continued to maintain that the generic name *Aspergillus* should apply not only to the conidial stage but also to the ascosporic stage. The genus *Aspergillus* is here to stay, regardless of rules of nomenclature." This statement should not be allowed to pass unchallenged by those who believe that progress in any branch of science dealing with living organisms will be facilitated by precise designation of the organisms concerned, and that such precision can best be attained by conforming to an established procedure based upon conference and agreement between as many as possible of those who are interested in such matters. In the mycological field, such a procedure is set forth in the International Rules of Botanical Nomenclature. Admittedly imperfect and incomplete (what codification of practice in other fields is perfect and complete?), the rules in their present form represent an orderly development of careful and intelligent thinking on the subject of nomenclature and are entitled to the serious consideration of all who use names subject to these rules. In the very rare cases in which it seems impossible to abide by them, the reader is entitled to a clear statement of the reasons for divergence.

In discussing the taxonomic position of the genus, Thom and Raper (p. 6) follow E. Fischer's treatment in Engler and Prantl (1896) and list *Aspergillus* "in its proper place" among the Ascomycetes. They then proceed to define *Aspergillus*, credited to Micheli 1729, as an imperfect fungus, inserting in the description, toward the end, "perithecia found in certain groups only, unknown in most species." *Eurotium* Link 1809 is not formally diagnosed, but is discussed in general terms and discarded "for practical purposes." No notice is taken of the fact that Fries's *Systema Mycologicum* 1821–32 is the starting point from which the application of both names must be determined, nor is the use of these names by Fries or those who immediately followed him cited. Both *Aspergillus* and *Eurotium* were adopted by Fries (1825, 1832) and previously, but after the publication of the first volume of the *Systema*, by S. F. Gray (1821). *Aspergillus* is certainly restricted, as it was originally by Micheli, to what we now know as imperfect fungi. *Eurotium* applies in large part, if not entirely, to what we now know are ascomycetous fungi, characterized by asci borne in cleistothecia, and can be readily typified so that there can be no possibility of confusion. The application of Article 57 of the rules has been all but universally followed in such cases in other Ascomycetes, and no good reason is given for making an exception in the case of *Aspergillus*. In any specific instance where a species of *Aspergillus* is known to be the imperfect stage of a species of *Eurotium*, then the species, as a unit, must be transferred to *Eurotium*. The imperfect stage will continue to be classed and keyed with the other Aspergilli, the occurrence of cleistothecia being noted only as one of its several distinguishing characters. The genus *Fusarium* affords an exact parallel. A number of species of *Fusarium* are known to be imperfect stages of various species of *Nectria* and allied genera. In every such case, the fungus, as a species, is properly transferred to its ascomycete genus. The imperfect stage remains a *Fusarium*, and since that stage is the one likely to be met with and is of dominant importance in the practical utilization of knowledge of these fungi, the species of *Fusarium* with known perfect stages will continue to be listed and keyed with the species in which no perfect stage is known. Linder's monographs of the helicosporous fungi and of *Oidium* stress the imperfect stages of these fungi and make the treatment of the perfect stages, where known, subordinate. As a result, they are much more useful than they would be had this not been done.

Thom and Raper's volume constitutes one of the most outstanding mycological contributions of recent years and will unquestionably prove to be one of the most useful. The question here discussed will seem of little or no significance to most of those who will use the work to their very great profit. It is all the more to be regretted that the attitude toward nomenclature is so dogmatically asserted and so completely unsupported by examination of the considerations involved.

G. W. MARTIN

State University of Iowa

Replies to Dr. Visscher

Eight of the country's leading educators, mostly chancellors and presidents of great universities, addressed to President Truman an "appeal for the deferment of college science students," which appeared in *Science*, 1945, 102, 500–501. Maurice B. Visscher, M.D., addressed an open letter to these educators (*Science*, 1945, 102, 674), expressing the confident belief that the implications of what they had signed "were not apparent to most of you."

If Dr. Visscher wishes to discuss osteopathy, and has the necessary knowledge to do so, that is one thing. But when he ascribes "stupidity or cupidity" to a man of the standing and accomplishments of General Hershey because the latter included osteopathic students among those subject to deferment, he shows a total lack of knowledge both of the background of General Hershey's act, and of the established attitude of Federal and state governments for many years.

When the Selective Service law was new, the Office of Production Management studied the situation and recognized the futility of expecting the M.D. heads of the Medical Corps in the Army or the Navy to permit osteopathic physicians and surgeons to take the examinations to demonstrate their fitness for commissions as medical officers. Therefore, it recommended to Selective Service that both osteopathic physicians and surgeons, and osteopathic students, be included among the lists of persons engaged in essential occupations and subject to deferment. Selective Service issued such regulations on 16 July 1941. That it was not a matter of whim or caprice is proved further by the fact that more than 17 months later, in December 1942, when the regulations were promulgated providing for the deferment of preprofessional students—premedical, predental, etc.—preosteopathic students also were included.

General Hershey's recognition of the essential nature of the study and the practice of osteopathy, and of the preprofessional training of those who would be osteopathic physicians and surgeons, is not an example of "stupidity or cupidity"; it is, on the other hand, exactly consistent with the attitude of the Federal government over many years—except as its intentions are thwarted by men who hold the M.D. degree and happen to be in places of authority, as in the Medical Corps of the Army and the Navy.

The Federal government paid for the education of veterans in osteopathic colleges following World War I and is doing the same now.

Congress has again and again appropriated funds for the payment of osteopathic physicians as medical officers in the Navy and of osteopathic physicians to serve in Army hospitals.

Congress has just passed a bill to set up a department of medicine and surgery in the Veterans Administration in which osteopathic physicians are specifically stated to be eligible for commissions.

Dr. Visscher's failure to recognize the care which university chancellors and presidents use in acquainting themselves with the implications of communications which they address to the President of the United States, and his lack of understanding of what lay behind what he chooses to term General Hershey's "stupidity or cupidity," is matched by his evident lack of understanding of the general governmental background of osteopathy.

The U. S. Employees' Compensation Act provides for payment to osteopathic physicians and surgeons and osteopathic hospitals for the care of government employees injured in line of duty.

The U. S. Office of Education recognized the American Osteopathic Association as the accrediting agency for osteopathic colleges and includes osteopathy among the professions concerning which it issues vocational guidance booklets.

The general temper of Congress was well represented in the action of the Senate on 30 May 1940, when it passed what was to have been known as "The Hospital Construction Act of 1940," providing, among other things, for a National Advisory Hospital Council with eight appointed members "selected from leading medical, osteopathic, or scientific authorities. . . ."

As long ago as February 1929 Congress passed, and President Coolidge signed, an act governing the practice of medicine in the District of Columbia and providing that "the degrees, doctor of medicine and doctor of osteopathy shall be accorded the same rights and privileges under governmental regulations."

In a number of states the law requires the inclusion on the State Board of Health of an osteopathic physician, and there is such inclusion in states where it is not required.

Dr. Visscher lives in a land where the privilege of free speech and a free press is often abused because it is not even required that what one says or writes shall be true.

RAY G. HULBURT, *Editor*

American Osteopathic Association, Chicago

. . . . Dr. Visscher's protest is directed to proposed selective service deferment changes, its import is clear as are the convictions of the author. . . .

For a scientist to attack viciously a concept about which he knows nothing merely suggests that he has stepped out of his role as a scientist and has become either a politician or an evangelist, in either case his mouthings can be discounted because they represent an emotional outburst and are not a product of his scientific knowledge.

It so happens that the exemption of osteopathic students and physicians from the selective service has been a wartime necessity not only as a means of utilizing the training and skill of everyone where it would operate to the best advantage, which in this case was the care of the civilian population, but also because the medical departments of the army and navy, for reasons of their own, consistently refused to commission osteopathic physicians and surgeons as medical officers, although the congress repeatedly implied its wish that they be so commissioned. The United States Public Health Service has commissioned a *few* osteopathic physicians. Because of this situation legislators and selective service officials were unwilling to draft a group of highly trained personnel badly needed, into the services as privates.

The performance of osteopathic physicians and institutions during the war has been most creditable. They stood up to everything asked of them and gave willingly as far as they were able to the war effort, without asking favor or special privilege.

Osteopathic institutions are not perpetrating "a fraud upon a gullible public," but are engaged in the serious business of training physicians and surgeons, able to meet the general medical problems of the average patient.

It is time that scientists shake themselves and keep pace with progress that is being made in allied fields before expressing themselves authoritatively about them, in terms and concepts that have long since been outgrown.

THOMAS J. MEYERS, D.O.

Pasadena

The type of discussion by Maurice B. Visscher, M.D., of "Osteopathy and University Presidents" strikes the writer as unfair propaganda, and as such is out of place in any scientific journal.

The article is out of place because it is an emotional and untrue discussion of matters which will stand investigation in an orderly, systematic, and scientific manner. We are not interested in the thesis of anyone who thanks God in the market place that he is holier or more learned than other men.

There is abundant evidence that there are just as many pious "frauds" in regular practice in the allopathic cult as afflict the oesteopathic school of medicine. But unlike the gentleman we woud not be so inaccurate or so uncharitable as to indict the whole allopathic cult because of the undoubted quacks within the fold. We believe that the great majority of the allopathic profession are just as scientific, just as honest, and just as faithful and hard working as the practitioners of the osteopathic school of medicine. . . .

CYRUS N. RAY, D.O., *Former Member,*
Texas State Board of Medical Examiners

Abilene, Texas

Transposition

I am sorry that I have to call your attention to a typesetter's error in our article which appeared in the January 11th issue of *Science*. Page 51, column 1, line 2 and line 11 are transposed. It is easy to see how the error was made because both lines begin with six identical characters.

HARRY SHAY, M.D.

Medical Research Laboratory
Samuel S. Fels Fund, Philadelphia

Book Reviews

Anatomy as a basis for medical and dental practice. Donald Mainland. New York: Paul B. Hoeber, 1945. Pp. xvii + 863. (Illustrated.) $7.50.

This textbook appears at a truly opportune time—a time when its subject matter is being extensively reviewed (and occasionally reviled) and debated (and not infrequently debased) by thoughtful, and thoughtless, people in and out of the teaching profession generally and by "anatomists" in particular. When these views are examined with somewhat more objectivity than is apparent in their preparation, one is tempted to draw an oversimplified conclusion that anatomy is successfully taught, by whatever method, only by good teachers—that, whatever the method, the bad teacher is faced with a hopeless task. One inescapable fact, however, emerges from the polemic: Anatomy, which a century ago was the most important subject of the preclinical years, faces a turbulent future and the mettle of its teachers is to be put to rigid test; classically a study of the dead, anatomy must be more closely related to the living. Many features of anatomy make it a uniquely difficult subject. For example, it lacks a gradual methodical buildup; the student is immediately plunged into the center of an ocean of material rather than being permitted to wade in from an introductory shoreline, as, for instance, in organic chemistry—hence the particular need for a well-oriented text. The effort of any anatomist to provide such is worthy of the most careful scrutiny; that offered by an experienced teacher and an anatomist of broad training demands thoughtful and open-minded consideration.

That Dr. Mainland is keenly aware of the present state of flux of anatomy is evident from his previous writings and is again emphasized in the earliest pages of this book. The author is of the obvious conviction that changes, both in principles and in methodology, are not only coming but are badly needed and should be welcomed by the profession. He advises us to look upon the reduction of allotted time, not with alarm, ". . . not as a matter of regret, but as a challenge . . ."; to recall that the chief function of medical and dental undergraduate education is to teach students to educate themselves; to face the fact that a large proportion of sensibly taught anatomy is practical anatomy and that, therefore, clinical problems must be introduced, though not pursued beyond the point necessary properly to illustrate the matter in hand.

The avowed purpose of the book, as stated by the editor of the Medical Student Series, of which this is a part, is to provide a ". . . full-bodied 'student' textbook, presenting what the student has time to read, at a price he can afford to pay." If the reader concludes from this that the book is an inexpensive substitute for the standard type text ("the old-fashioned compendium," as Dr. Zapffe refers to it), he will be wrong on two counts: the price is not low, and the editor himself tells us that it ". . . obviously will not supplant the larger text." That the latter is true is immediately evident upon examination of the body of the text.

The book is divided into three major sections. Part I, entitled "Aims and methods," is a short introductory chapter (26 pp.) which seeks to orient the reader by giving him some history of the subject, ancient and recent, and by indicating the position of anatomy in medical education and practice. Part II, called "General anatomy," consists of 124 pages of systematics. The body is first examined as a whole, statistically as well as physiologically, and then its classical parts—bones, muscles, nerves, etc.—are discussed, not individually, but generally, with a view to establishing fundamental principles. Part III, comprising the main portion of the book, consists of eight chapters (586 pp.) of regional anatomy, except that within each chapter covering a particular region material is approached systematically; thus, in the section on the upper limb, bones and movements are discussed first, with skin, muscles, blood vessels, nerves, etc., following in that order.

Seven appendices (47 pp.) give much adjuvant information on such diverse matters as radiology, reading and writing, postnatal ossification dates, and normal organ weights. Scattered at appropriate intervals throughout the main portion of the text are questions calculated to direct the student's attention to the practical application of anatomical knowledge. While a number of these questions, individually taken, are not above criticism, and many are perhaps beyond answering in the dissecting room, as a whole they offer the student the opportunity to convert immediately a rather disjointed mass of anatomical facts into a useful body of serviceable information. Answers to these questions are provided in the back of the book. An exceptionally fine classified list of references is followed by the usual index. Only a relatively few (61) schematic line drawings are included in the book, since it is clearly meant to be used in conjunction with an atlas. It might be pointed out here that Fig. 52 should be corrected to show postganglionic parasympathetic fibers to the heart.

A cursory examination of this book gives the erroneous impression that it represents merely an adumbration of anatomy, but whereas most of the written text is presented in a more or less synoptic form, the book is in no sense an expanded syllabus. While it omits much of the irrelevant detail of the standard descriptive anatomical text, it skillfully introduces recent pertinent advances in both the structural and functional aspects of the subject. It should be made clear, however, that if the reader seeks a concise, easily located, and reasonably complete and accurate description of a particular structure, he must perforce turn to the "old-fashioned compendium." If the student desires information on the external maxillary artery and turns to the book under review, he finds it indexed only under the B.R. term: *Artery, facial*; he is then directed to four widely separated pages, where the vessel is referred to, in sections, as the *external maxillary (facial) artery*. Such imperfections, if they are considered such, are patently inherent in the form of presentation used in this book. It may be well to note at this juncture that the author does not feel bound by any single official terminology. B.N.A. terms predominate, though given in English form, but ". . . when B.R. terms are obviously better they are used, and B.N.A. terms are given in parenthesis. A few other commonly used terms are mentioned." Such a liberal attitude toward authoritative nomenclature undoubtedly has its merits, particularly in an effort to get away from the stilted, stylized phraseology of the majority of texts; however, this reviewer deplores the sanctioning of such terms of direction as "headward" and "tailward."

Rather loosely-worded sentences, often introductory in nature, occur here and there throughout the text. To cite a few examples: "Right and left pleural cavities contain their respective lungs"; "The pleura is smooth and glistening because slightly moist, to minimize friction of lung movement"; "Nerve fibers (autonomic) send no messages to consciousness"; "Vagi are largely food passage nerves. Therefore they supply air passages also"; "The fluid containing the ovum is squirted by the rupturing follicle directly into the tube which sucks it toward the uterus." Also, in a book where purposeful omission of nonessential detail is an expressed policy, it is surprising to come upon material of such dubious value as a description of Gudden's commissure, an excessively long discussion of Wolff's law, an enumeration of the constituents of tartar, and the extraordinary mnemonic which reads: "'Sphincter' and 'sympathetic' both begin with *s*; therefore one might expect them to be linked; but they are not." While it is well recognized that the introduction of controversial material may, in selected instances, be quite justified and stimulating, it is difficult for the present writer to see the virtue of including in an anatomy text statements of debatable relevancy, some of which are dangerously dogmatic, if not misleading, and which deal with highly disputatious topics—for example: "Mental defect indicates structural defect of the brain . . ."; "In [heart] disease myocardial vessels grow into the cusps; therefore when rheumatic valvular disease is found, the physician should conclude that the myocardium is also infected . . ."; "Stimulation . . . in man shows that the motor area is not always confined to the precentral gyrus. . . ." An inconclusive discussion of the events occurring in cardiac hypertrophy and dilation, following valvular lesions, and an unconvincing dismissal of the Purkinje fibers as significant constituents of the conducting system of the human heart might be added to the above list.

Outright contradictions are rare in this book, but one might easily be led to interpret as such these sentences touching upon the mechanics of respiration: "In expiration . . . the main factor is perhaps elastic recoil of the lung . . .," and, on the next page, "Expiration results largely from weight of the thorax, spring-like qualities of costal cartilages, and some contraction of anterior abdominal wall muscles."

As is true of J. C. B. Grant's excellent *Method of anatomy*, the only text remotely similar to the book under review, attention is directed primarily toward fundamental principles and away from superfluous details. The student is properly urged to conduct his dissection in a spirit of investigation. In fostering the cultivation of independent powers of observation and in making clear immediately the value of information gained, this book goes a long way in encouraging the student beyond what Mall referred to as the first and easy step of anatomy—the dissection of the body—to a deeper, more practical, and synthetic mental impression of it. No one text can hope to satisfy all conditions demanded by all instructors in all courses, and to prognosticate the reaction of students to a new text is a task for the soothsayer, not for a mortal reviewer. Final test of any text lies, of course, not in its review, but in the crucible of the classroom; this book most certainly deserves that test and the thanks of the profession must go out to this—and indeed to any—effort to rid the teaching of anatomy of ". . . the pernicious effect of dogmatism . . . more manifest in it than in other medical sciences."

ROLAND H. ALDEN

Division of Anatomy
University of Tennessee
College of Medicine, Memphis

Your eyes have told me. Louis H. Schwartz. New York: E. P. Dutton, 1945. Pp. 208. (Illustrated.) $2.75.

This book is not for the scientist who wants precise and accurate information and has the mental discipline and intelligence to understand it. It is written in a free and easy style for the layman, and since the information it contains outweighs the misinformation, it will probably be of benefit to the lay reader. In the Preface and Epilogue the author records his intentions concisely: "The purpose of this book is to give the reader a better insight into one special branch of that vastly absorbing maze of perplexities, the human body." Between these two portions of the book lie 31 chapters of popular science writing, frequently careless, usually overdramatic, generally trite, too often gullible.

"The Siamese Twins" is a discussion of sympathetic ophthalmitis; "Cherchez la femme," of gonorrheal ophthalmitis; "Popeye Clinic," of exophthalmos; and "The Greeks had a word for it," of nystagmus. The ophthalmologist is shocked to find a visual acuity of 20/50 described as 40 per cent of normal, and the psychiatrist must be disturbed to read of hysterical blindness, usually a symptom of some deep-seated difficulty, being treated with a placebo and some strong suggestion. The discussion of cross-eyes serves only to confirm most of the layman's misconceptions regarding this condition, and in the extremely confused chapter on color-blindness the author is as gullible as any layman regarding the types, classification, diagnosis, and possibilities of curing the condition.

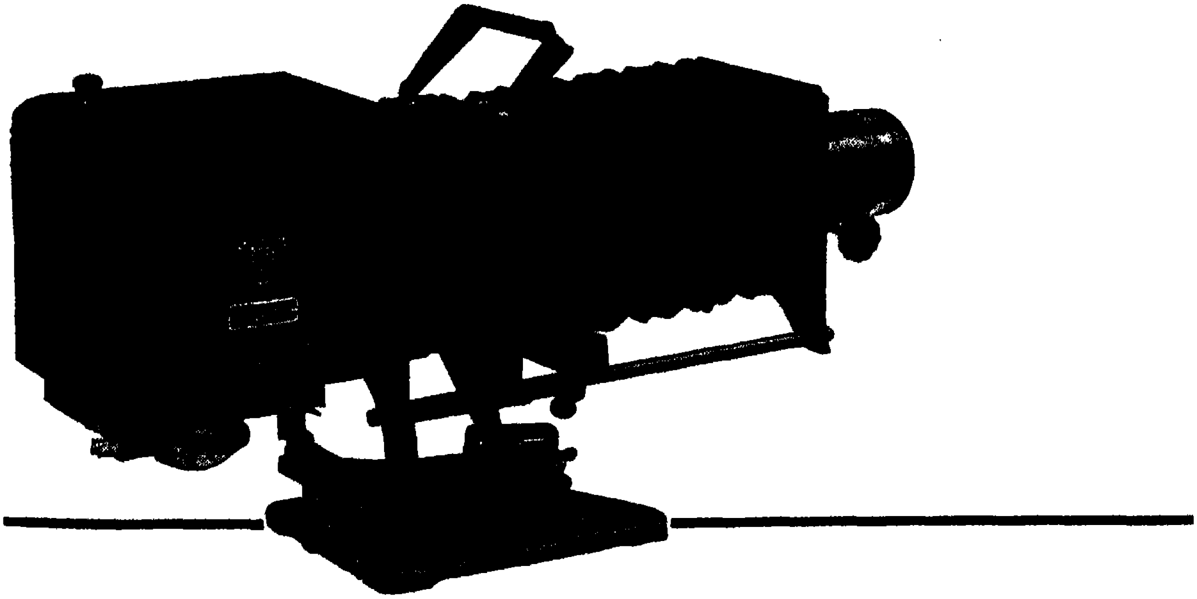
If we accept the proposition that the best way to fight rackets and charlatanry is by educating the public, then

BAUSCH & LOMB

BDT

BALOPTICON

To the instructor or lecturer, this Bausch & Lomb Balopticon is one of the most valuable aids he can have. Using standard lantern slides, it projects clear, sharp pictures that are brilliant enough to permit adequate room light for note-taking. This model has an adjustable tilting base which permits the Balopticon to be used in many different locations such as a slanting desk top or drawing table yet be tilted and leveled so that the picture is shown symetrically on the screen. Write for Catalog E-11, "Balopticons and Accessories." Bausch & Lomb Optical Co., Rochester 2, N. Y.



BAUSCH & LOMB
ESTABLISHED 1853

more books on technical subjects written in easy language are advisable. Dr. Schwartz's Preface is an excellent piece of writing for the layman. It is unfortunate that the quality of this part of the book was not continued into the subsequent chapters.

LEGRAND H. HARDY

Knapp Memorial Laboratories
Institute of Ophthalmology
New York City

Text-book on spherical astronomy. (4th ed.) W. M. Smart. Cambridge: at the Univ. Press; New York: Macmillan, 1945. Pp. xii + 430. $4.75.

The fact that this book comes out in the fourth edition only thirteen years after its first publication is in itself an indication of its usefulness. The popularity of Smart's text is undoubtedly due to its comprehensive scope. Crossing freely the traditional frontiers of spherical astronomy, the author leads the student from astronomical coordinates and methods of position measures to the study of planetary motions, stellar motions, and binary star orbits. Included in the book are such subjects as the application of photography to astronomical measurements, the prediction of occultations and eclipses, heliographic coordinates, etc., for which adequate treatment in textbooks has not been available.

In a clear, fluent style the problems are skillfully developed with relatively simple mathematical tools. Many excellent diagrams help the understanding, and the technique of shading used for illustrating three-dimensional relationships is most successful. Each chapter is followed by a set of exercises by which the student can test his mastery of the subject.

While complete and rigorous treatment of all problems is hardly to be expected in a textbook of this kind, it seems to the reviewer that a derivation might have been given for the principal terms of precession and nutation. This would probably have avoided a serious mistake in Section 134, where the semiannual term of Nutation is erroneously attributed to the ellipticity of the earth's orbit instead of to the change in the sun's declination.

The fourth edition differs little from the second and third except for a few corrections and changes in numerical values of constants. The use of thinner paper, however, makes the volume more compact without impairing the legibility.

R. J. TRUMPLER

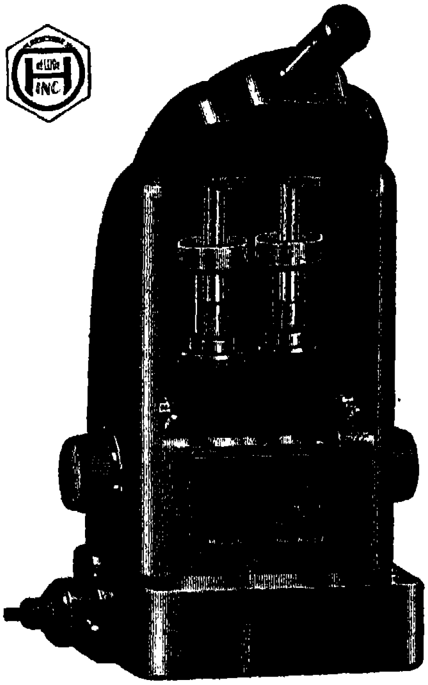
University of California, Berkeley

Scanning Science—

Macmillan & Co. announce a work on "Social Interpretations of the Principles of Mental Development," by Prof. J. Mark Baldwin, of Princeton, and "An Outline of Psychology," by Prof. E. B. Titchener, of Cornell University.

—7 February 1896

HELLIGE
DIRECT READER DUBOSCQ
COLORIMETER



Here, at only $75.00 is a complete Duboscq Colorimeter which embodies an unusual combination of striking features not found in any other instrument for this purpose. This precision colorimeter is, therefore, offered with an unbounded challenge to a point by point comparison.

Permanently reliable, non-fading Glass Color Standards, the production of which was interrupted due to the urgent requirements of our Armed Forces, are now again on our production schedule, and will soon be available for all popular clinical tests.

Write Today for Bulletin No. 250-A

HELLIGE
INCORPORATED
3718 NORTHERN BLVD.
LONG ISLAND CITY 1, N.Y.

WILEY

A new book for a new technique . . .

December
1945

ELECTRON OPTICS
AND THE
ELECTRON MICROSCOPE

By V. K. Zworykin, G. A. Morton, E. G. Ramberg, J. Hillier, A. W. Vance; all at RCA Laboratories, Princeton, N. J.

CONTENTS

Part I—PRACTICAL ELECTRON OPTICS AND ELECTRON MICROSCOPY • Electron Optics • Applications of Electron Optics • Electron Microscopes • Electron Optics of High Magnification • The Magnetic Electron Microscope • Aberrations and Tolerances in the Electron Microscope • Electron Microscope Power Supplies • Manipulation of the Electron Microscope • The Electron Microscope as a Research Instrument.

Part II—THEORETICAL BASIS OF ELECTRON OPTICS AND THE ELECTRON MICROSCOPE • Theoretical Basis of Electron Optics • Determination of Potential Distribution • Electron Trajectory Tracing • Gaussian Dioptrics of Electrostatic Lenses • Magnetic Fields • Electron Motion in Magnetic Fields and Magnetic Lenses • Aberrations of Electron Lenses • Magnitude and Correction of Electron Lens Defects • High-Voltage Electron Optics—Ion Optics • Image Formation in the Electron Microscope.

APPENDIX

This comprehensive book covers the electron microscope in all its phases. The material for the book was chosen to fulfill a twofold purpose. The first is to aid the present or prospective electron microscopist in understanding his instrument and in using it to greatest advantage; the second, to present systematically the practical and theoretical knowledge which must form the basis for further progress in electron microscope design.

To this end the book has been divided into two parts. The first part contains descriptions of various types of electron microscopes together with a non-mathematical discussion of the electron optical theories on which the electron microscope is based and the practical information necessary for its effective operation. The second part presents a survey of theoretical electron optics and employs mathematics as liberally as a methodical development of the subject matter warrants. This treatment is intended to supplement the practical information of the first part and may serve as a guide in electron-optical design.

747 pages
5 5/8 by 8 5/8
$10.00

JOHN WILEY & SONS, Inc., 440-4th Ave., New York 16, N. Y.

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Portable water bath. The Barnstead Company is now producing a low-cost water bath which is suitable for use in either industrial or educational laboratories. The bath has seven openings with concentric covers, and the outer holes are numbered for convenient identification. The entire exterior is of Monel Metal and the interior is of tinned copper. Immersion-type, electric heating elements provide a high heat of 1,000 watts or a low heat of 500 watts. Bottle-fed, the bath can operate for 10 hours on low heat or from 4 to 5 hours on high heat. *New water bath by Barnstead. Bulletin No. 108 SC-462.* Barnstead Still and Sterilizer Company, Inc., 2 Lanesville Terrace, Boston 31, Mass.

Spectrographic analysis equipment. The Jarrell-Ash Company has published a large brochure giving detailed information about its line of equipment for use in research involving spectroscopy and spectrochemical analysis in metallurgy, mineralogy, agronomy, chemistry, and medicine. All of the company's instruments employ the stigmatic type of mounting for the grating, as originally suggested by F. L. O. Wadsworth. The advantages claimed for such granting mounting are that the spectrum is anastigmatic and the design lends itself to a plateholder which covers an exceptionally wide range of spectrum at one setting. A large chart shows synoptically the main characteristics of each piece of equipment, and at the foot of each column a diagram gives the dimensions of the particular piece of apparatus. In addition to its own line of manufacture the company also sells the equipment of Adam Hilger of London. *Spectrographic equipment. Brochure SC-462.* Jarrell-Ash Company, 165 Newbury Street, Boston 16, Mass.

Engineering instruments. The Leupold and Stevens Instrument Company has sent in a copy of its catalogue of instruments used by hydraulicians, surveyors, hydrologists, and meteorologists. Some of the equipment described is: water-level recorders; deflection meters; differential floats; remote registering systems; hydrographic accessories, such as USGS wire weight gages and sounding reels, pitot tubes and weir blades; snow-rain recorders; and surveying instruments. *Bulletin 23* (2d ed.) *SC-462.* Leupold and Stevens Instruments, 4445 N. E. Glisan Street, Portland 13, Ore.

Constant vacuum control. The Wallace and Tiernan Company has developed an aneroid manostat for use on problems involving extended periods of vacuums. The instrument was developed to keep vacuums absolutely constant and to offset complications because of barometric changes. Two ranges are available—one for vacuum systems only and the other for both vacuum and pressure systems. Both are designed for general use in laboratory and industry in the calibration and testing of pressure-sensitive instruments in high vacuum distillation and in vacuum-tube production and research. The instrument can be adjusted to 0.005 inch of mercury and under normal laboratory conditions will hold the controlled system at set pressure almost indefinitely without visible deviation, regardless of changes in the source of vacuum, pressure, or variations in barometric pressure. *Aneroid manostat, Technical Publication 257 SC-462.* Wallace and Tiernan Company, Belleville 9, N. J.

Powder metallurgy. One of the newer engineering developments is the manufacture of metal powders into finished products or vice versa. Back of the process is much fundamental research, and college instructors who teach in the chemical engineering departments or development engineers looking for economical production methods will want to read this brochure. In it are described the methods and techniques employed in the process, the advantages and disadvantages, together with the limitations of the process and numerous successful applications. Engineers will be particularly interested in the detailed specifications given for self-lubricating bearings. *Powder metallurgy. Brochure SC-462.* Keystone Carbon Company, Inc., Saint Marys, Pa.

Vacuum pumps. The W. M. Welch Manufacturing Company has furnished this office with a copy of a booklet devoted exclusively to its line of Duo-Seal vacuum pumps. In addition to outlining complete specifications for various types of pumps, including single and two-stage pumps, distillation pumps, and vacuum gages, there are extended discussions of the principles and history of this type of laboratory apparatus. Performance curves are given, together with formulae for calculations to determine load factors. *Duo-Seal vacuum pumps. Brochure SC-462.* W. M. Welch Manufacturing Company, 1515 Sedgwick Street, Chicago 10, Ill.

Entomological supplies and equipment. A wide range of necessary supplies and equipment for field and laboratory work by the instructor, researcher, and student are described in the latest catalogue from Ward's Natural Science Establishment. Among the items listed are insect-collecting equipment, insect-killing apparatus, pinning, spreading, and mounting materials, cases and boxes for displaying and storing insects, and cabinet drawers and trays. An insert tells about a completely adjustable holder for microscopic study of insects. By means of a constant axis mechanism complete dorsal and ventral coverage can be had, and light can be found at every possible angle. *Entomological supplies and equipment. Catalogue 455 SC-462.* Ward's Natural Science Establishment, Inc., Box 24, Beechwood Station, Rochester 9, N. Y.

29 MAR 1946

SCIENCE

Vol. 103, No. 2666 Friday, February 1, 1946

The Importance of Scientific Research in the Postwar Era[1]

George R. Harrison
Massachusetts Institute of Technology

THIS IS AN ESPECIALLY GOOD TIME to discuss the relation of research to postwar industry and agriculture, for not only has the postwar era arrived with a bang, but there has been a major change in the whole relation of science to the social structure within the past eighty days. I am therefore especially pleased to come at this time to Birmingham, where so promising a start has been made by the Southern Research Institute.

I need not tell this audience that the prosperity of the South depends on expansion of southern industry. Everyone present is aware that scientific research furnishes one of the most effective ways of promoting agriculture and industry. It is easy to quote exact figures in almost any industry one may choose to show how research has made possible a better product at a cheaper price, thus increasing sales and boosting both profit and wages. Department of Commerce figures show that, in 1926, two hundred thousand mechanical refrigerators were sold at $400 apiece. As a result of research and the increased know-how which resulted, a much better refrigerator could be sold ten years later for $160, or less than half as much, so two million, or ten times as many, were sold. In the radio field similar figures can be quoted. In 1926 one and three-quarters million radio sets were sold at an average price of $114. Ten years later, sets which were far better cost an average of $54.50, or less than half as much, and eight and a half million, or nearly five times as many, were sold. You may say that much of this improvement can be credited to the development of improved methods of production, but no one will deny that the most direct way to develop such improved methods is to study them systematically—in other words, carry on research.

In citing specific examples of effects of research on industry, I shall steer clear of selecting those dealing with our own Southland, regarding which you are so much better informed than I. Instead, for cotton I shall substitute wool and refer to a land much farther South and about 180° West. If you think your area needs industrial expansion, take a trip to the Antipodes, where nearly half the people in a continent larger than the United States live in three great cities hundreds of miles apart. The transportation system connecting Brisbane, Sydney, and Melbourne in Australia until recently consisted of slow-moving vessels plus a series of railways, much of whose rolling stock was discarded by the Long Island Railroad in 1905. I use Australia as an example, because its needs for research are similar to, but even more extreme than, those of the southeastern United States, and because the Australians have in recent years shown the same progressive spirit as yourselves and the same realization that scientific and technological research is the only answer to their most pressing problems. They are following this approach with the same vigor and success which mark your own efforts.

A year ago I spent several months in Australia. Like that of the South, her economy has been built up largely on primary rather than on secondary industries, and thus chiefly on wool, wheat, beef, and mutton. This is all very well in normal times, when an empire will take your wool, scour and weave it, and give back manufactured products in exchange. Most of the profits remain in the empire, however, and in an emergency weaknesses begin to show up. During the war there was a great shortage of lanolin for greasing rifles in Australia, although most of the world's lanolin originates there. In normal times wool was shipped from Australia to France, where the lanolin was removed and purified; then the wool went on to England for further processing, and some of the lanolin went back to Australia. When France fell, the lanolin industry disappeared, and Australians did not even know how to get lanolin out of their own wool.

Recent years brought a still worse bugaboo to terrify the wool grower (for "wool" read "cotton"). New textile materials were appearing from research laboratories in other countries. Rayons and nylons entered the market, and rumors were heard of even more dangerous competitors of wool. The Australians did not take this sitting down. Their very effective Council for Scientific and Industrial Research put to work research scientists who soon discovered a new way of greatly reducing the shrinkage of wool by treating the fibers before the spinning process. They also set to work on the problem of making woolen strands distasteful to moth larvae and were having a fair degree of success at the time of my visit.

---

[1] Address delivered before the Advisory Council, Southern Research Institute, Birmingham, Alabama, 25 October 1945.

The Council for Scientific and Industrial Research has under its direction ten active research laboratories to serve seven million people. How many people are there in the southeastern United States?

I saw another example of Australian vigor in research in the optical industry. When the Japanese were coming over the Kokoda Trail in New Guinea and the people of Queensland had their automobiles loaded to move their families south at a moment's notice, the Australian optical industry consisted of a fine collection of sand banks. The Armed Forces needed optical instruments of the highest quality—roof prisms for range finders, for example, which had to be accurate in angle to within two seconds so that rays of light reflected by them would not deviate from their correct path by more than one foot in twenty miles. Ordinarily, these could be made satisfactorily only by the most skilled optical workers having years of experience. The Australians converted three academic laboratories into optical plants, made their own optical glass from local materials, and soon developed the needed skills for fashioning the most delicate optical parts. Two university physics departments had optical shops in quantity production when I was there, and astronomers in the Commonwealth Observatory, high up on Mount Stromlo, had taken their gaze from the stars and were working on tank telescopes. So successful were their efforts that they were shipping large quantities of roof prisms to the Frankford Arsenal in Pennsylvania. Now Australia has an optical industry.

Though there are said to be at least 2,264 industrial research laboratories in this country, too many corporations have set up what they call research laboratories, which are merely developmental and trouble-shooting laboratories. It is not easy for a board of directors to decide to invest funds, labor, and equipment when some direct, immediate return cannot be seen; yet that type of faith and imagination is what is required if the greatest financial return is to be realized. The greatest practical returns from research come when one is willing to cast his bread upon the waters and relax, as far as that particular bread is concerned, secure in the knowledge that eventually it will return manyfold.

The small industrial corporation cannot support a research laboratory of its own, yet it cannot afford to get along without research for improving its product and developing new products. It is to supply the need of such firms that such laboratories exist as those of the Southern Research Institute, the Mellon Institute, and the various university foundations, of which the Division of Industrial Cooperation, Massachusetts Institute of Technology, is typical. This is the first stage.

As a firm builds up its organization it ultimately reaches a point where it can support a research laboratory of its own. This is the second stage. But if any industry is satisfied to stop with even the second stage, its profits will remain at a level far below that which proper acumen makes possible. The needed third stage is that which may be called directed basic research, a typical example of which is given by the sugar industry. A large number of manufacturers of cane and beet sugar have banded together in the Sugar Foundation, which supports research on the chemistry of sugar in a large number of university laboratories. What is wanted is more information about sugar and what it is good for. When this information is obtained, the public will benefit in obvious ways, and the sugar industry will benefit from increased use of its product. Such broad-minded research is spreading as the benefits to those who support it become apparent and has already produced remarkable results in a large number of fields.

The fourth stage we may call "disinterested basic research." This is the most important of all, for without it the others soon lose sustenance. In years past it was difficult to convince a board of directors that they should make contributions which would enable a "dreamy" scientist to work in his laboratory at whatever he pleased. If they had not come to see that no apparently isolated fact is useless, and that the nonavailability of any particular bit of information may later make impossible the solution of a specific problem, American prosperity would be on a far lower level than it is.

Fundamental research usually could not in the past be undertaken with guaranteed immediate profit by any one company or even by one industry. It had to be supported by the whole economic community because it was of such broad scope. It was carried on chiefly in the research laboratories of universities and the great foundations. Thirty years might elapse between the discovery of the photoelectric effect, for example, and the development from it of an electric eye for television and talking motion pictures; or between the discovery of the electron and the development of an electron tube for radio, or radar, or telephony, or a dozen other new industries. Yet this period is being shortened rapidly, for the more we know, the more we are able to find out, and the greater the number of pieces which have been fitted into the jigsaw puzzle of nature, the easier it is to fit in the remaining pieces, even though the area of the picture grows larger all the time.

Fundamental research is now, however, becoming a profitable undertaking for some of the larger corporations. The director of the Research Laboratory of the General Electric Company some years ago told me that he and his predecessors spent much of their time trying to get their research personnel back into the fundamental research which they had started thirty years ago. The original idea of their laboratory was the disinterested study of nature, because its director, Dr. Whitney, had the imagination to see that this was what would pay most in the long run. Over and over again, researchers in such laboratories as those of the General Electric Company and the Bell Telephone Company have been set to work in some field of fundamental research only to have one after another profit-bringing result intrude itself upon their notice.

I suppose that the reason digging for truth is not only more interesting, but more profitable, than digging for gold is that if urged on by the love of digging, one digs more deeply than if searching for some particular nugget. Practicality is likely to be shortsighted and looks so hard for some single objective that it may miss much that nature presents to one who is purposely digging for whatever may turn up.

When someone succeeds in inventing a gun which will shoot a bullet around a corner, it may become reasonable to expect to predict the outcome of any individual piece of research—that is, of real research as distinct from mere development. Progress in science is almost always made around corners instead of in straight lines. Most great discoveries have been made out of the corner of someone's eye. The most successful research laboratories are those in which funds are allotted to support research activities, a crew is set to work, and then everyone stops worrying about whether any particular job is going to pay back its cost in one year or ever.

The director of one of our most progressive research laboratories once told me with great pride that he had guessed wrong on nine out of ten of the greatest developments that had come from his laboratory. He was proud, not of the incorrectness of his guesses but of the fact that he never let them stand in the way of progress. When one of his young men came to him with a bright idea, he usually spent half an hour shooting it full of holes. Then, as the young fellow turned away, disappointed, he would say, "Go ahead and try it anyway. Work on this a bit and maybe you can prove me wrong." The young man worked, and although his original idea may have turned sour, something usually came of his research which led eventually to a new product, as likely as not to be more important than the one originally contemplated. You mak ask, "What is the function of a research director who is wrong nine times out of ten?" My friend said that his function is to listen to a man whenever he has an idea, give him credit when his ideas work, and see that he is kept cheerful so that his ideas continue to flow. As a result of this far-sighted policy, this corporation has ridden out all the ups and downs of economic storm, is almost without competition in its field, has stocks which are always considered to be a gilt-edged investment, and makes most of its profits from products which were not even thought of fifteen years ago.

Several years ago, Dr. Karl Compton told the National Association of Manufacturers that 2 per cent of the gross income of any industry could be expended effectively on research. Since then, this advice has been amply borne out, and the world has been plunged into a war in which the value of research has been demonstrated for all to see, as the strength of nations has been primarily their scientific and industrial strength. Britain was saved by the Royal Air Force, but it was only by a Royal Air Force implemented by the Radar that their scientists furnished in the nick of time. Since then, the Office of Scientific Research and Development under Dr. Vannevar Bush, skimming the cream of American scientific effort, has successfully aided our Armed Forces with a constantly increasing flow of new weapons and devices, which, taken in conjunction with those developed by the Services themselves, kept us abreast, and often ahead, of similar German advances. Those who expect great peacetime technological advances as a result of this extra wartime effort will not be disappointed, but it is still too early to discuss many of these advances in any specific way. One can only point to those industries involving air transport, electronic devices, food technology, and medicine as obvious examples of fields in which great strides are being made.

I should like nothing more than to be able to give you a list of new products of the next decade in the way of foolproof family airplanes; cheaply operated deep-freeze refrigerators; new types of cookery involving infrared rays and high-frequency radio waves; new runless, snagless super nylon fabrics; new medicines rendering atabrine, penicillin, and the sulfa drugs obsolete; new insecticides like DDT but selective so that, though they deal death to a mosquito or a fly, they furnish nourishing vitamins to a honeybee; fluorescent lamps that burn softer and brighter than our present lamps; plastics that can be molded with a putty knife, only to set into hardness that cannot be dented with an ax; metals lighter than aluminum yet as strong and cheap per unit volume as steel; synthetic rubbers of a dozen kinds, so that while one gives a tire that will roll a hundred thousand miles, another makes tougher and thinner raincoats which do not run, stick, or offend the nostrils. I could go on endlessly with such a list, but you have all heard the predictions. The limitation on such prophecies is that the items we can foresee are only the minor ones; the unwritten part of the list will expand into a thousand additional devices which have not yet been thought of, but which the next generation will consider essentials of living. So, if you ask for a list of the better things which Americans can expect someday to have available, I refer you to a list of what Americans want. So great is my faith in the ability of the chemist ultimately to put atoms together into any kind of molecule that may be needed to produce any desired drug, plastic, textile fiber, vitamin, or rainbow-colored dye, and of the physicist to discover new kinds of X-rays to see through steel, new Radar waves to see through clouds, to shell electrons out of atoms to operate the new radios, televisors, multichannel telephone sets, and sound recorders, that I set no limit on the ability of nature, fundamental and applied research, and American industry to furnish what is wanted.

So, let the American citizen, or the citizen of any nation, make out a list of the things he would like to own. Let him list a car for every member of the family and a radio in every car if his imagination will not provide him with anything better. Then someone will ask, "Who is going to pay for all this?" It is a good question, but it shows ignorance of the nature of wealth. Our national debt, now touching three hundred billion dollars, merely involves the redistribution of purchasing power. And while it entails problems of its own, we are discussing now the over-all wealth of the South, of the nation, and of the world. Purchasing power means ability to get all of these things, these better products we are talking about, and involves only two things—energy, and the knowledge of how to control it. When people want better food, clothing, shelter, health, transport, education, security, and relaxation, they are presenting problems involving improved control of energy. After all, the cave man had all the iron, copper, and other materials necessary to make himself a fine refrigerator; and every single iron atom used in building our normal four million cars per year was present on earth in Archimedes' day. Why is the purchasing power of the American citizen twenty times as great as that of a Chinese coolie? You know that it is because he can produce more than twenty times as much output. He knows how to direct and control industrial power by the flow of energy. Increase the amount of energy he can control, and you can afford to increase his wages and his purchasing power. Each day the average American citizen consumes energy which, if produced by the human arm as used in pumping water or sawing wood, would require three daily shifts of thirty men each; that is ninety men working eight hours a day. The American citizen can have this energy because it need not be produced by the human arm, but is furnished instead by Diesel, steam, and gasoline engines and by electric motors.

Can the purchasing power of the American workman be further increased? Of course it can. There is no Malthusian law which says that the wealth of the world is so much and this is not enough to support more than so many millions of people. What sets the limit to social wealth at any moment? It is the amount of energy the average workman is able to direct and control effectively. Double this, and you double the national wealth level, the profit level, the wage level, and the purchasing power of the individual.

What sets the limit to our ability to direct energy? First, it is having the energy to direct, and here we need have no worries. We have always had thousands of times as much energy available as we have been able to control. Let the oil pools be exhausted in ten or a hundred years; let the coal fields disappear in one century or ten; forget about the uranium atom and other sources of atomic energy—if you can. Every day the earth soaks up enough energy from the sun to run all the industries of the world at their present rate for two hundred thousand days to come. Some of this energy we now use in water power and in farming, and I know of no scientist who worries much about our ability ultimately to learn how to harness a larger fraction of the remainder. Our wealth level can be raised two thousand times over what it is at present and still leave a greater than one hundredfold factor of safety. Research will show how best to direct and control this energy, and only research can bring us this wealth.

In conclusion, I congratulate you of the Southern Research Institute on the splendid start you have made. I hope, however, you will not sit back and be satisfied. Build up your industrial research and research in your universities and colleges, for in the long run the whole thing depends on one product—men of imagination. I cannot believe that in this product the South is not equal to any place on earth.

The Science Section of Biarritz American University

Stanley A. Cain, *Chief*

BIARRITZ AMERICAN UNIVERSITY and its slightly older sister at Shrivenham, England, are experiments in education under Army auspices that deserve to be described for American educators.

ORGANIZATION OF THE UNIVERSITY

The organization of Biarritz American University is in many ways different from that of the usual university in the States. There are two reasons for the differences: Not only is this installation responsible for all housekeeping and service functions, as well as for the usual academic ones, but it also has the dual organization of the military and the civilian academic line-and-staff structures.

The Commandant, Brig. Gen. S. L. McCroskey, assisted by an executive, an assistant executive, an aide, and an office staff, has complete responsibility for BAU and, consequently, final authority. Attached to his office is a Visitors' Bureau. The chain of command separates from the Commandant to the directors of six divisions. Under the *Director of Administration* are the staffs and functions of Post Administration, Academic Administration, Finance, Military Personnel, and Civilian Personnel. Under the *Troop Commander and Headquarters Commandant* are numerous responsibilities and functions. The Headquarters Student Brigade has control of the five battalions into which the 4,000 students are organized. The Station Complement includes six companies which must supervise or carry out guard, labor, supply, utility, billeting, special service, military police, motor transportation, and other duties. Also under Headquarters are the Hospital, the Fire Marshal, and the Billeting and Mess Sections. The *Director of Supply* is in charge of the sections of Post Supply, Academic Supply, and Transportation Movements. The *Director of Special Services* has charge of Athletics, Recreations, Post Exchange, Special Supply, and Band sections. The *Special Staff* is not headed by a Director, each of its chief officers having direct access to the Commandant. The offices of the Special Staff are those of Public Relations, Surgeon, Chaplain, Staff Judge Advocate, French Liaison, Supervisor of Women, Historian, and the Academic Adviser. Under the *Director of Academics* are eight academic sections which correspond to colleges and the overall functions of Visual Aids, Library, Book Shop, and Counseling Section.

The task of fitting an installation of this size and complexity into the pre-existing buildings of a resort city has been a difficult one which the Army has in general accomplished with great speed and efficiency. In addition to garages, storage houses, department stores, casinos, and sundry other buildings, it has been necessary to requisition about 85 large and small hotels for student billets, about 65 villas for staff and faculty billets, and enough other space in hotels, villas, etc. for about 100 classrooms and laboratories and some 60 offices. There is also space for a library seating about 400 persons, a theater, a music hall, recreation halls, a gymnasium, clubs, etc. In order to provide other necessary services there are two dispensaries, a field hospital, sales stores, a shoe shop, cleaning and laundry shops, a bicycle shop (with about 700 bicycles), and numerous other aids to efficient and comfortable living. The total personnel of the installation, in addition to 4,000 students and about 275 faculty members, includes the station complement, several British Civilian Volunteer secretaries, numerous French civilian secretaries, clerks, waiters and cooks, and a labor battalion of German prisoners of war. In a school community at home the university organization does not include all persons serving the student body in any way, as it must in an independent installation in a foreign country.

PERSONNEL

The *Academic Division* is headed by a director, Col. E. B. Thompson, whose role is similar to that of the executive vice-president or dean of the university in some schools in the States, and who is directly responsible to Gen. McCroskey. John Dale Russell, who is academic adviser on the Special Staff and has direct access to the Commandant, is usually referred to as "Dean" and is chiefly responsible for academic policies, working in close cooperation with Col. Thompson. Dean Russell's executive officer is Lt. Col. Frances H. Horn, and Col. Thompson's staff (with Lt. Col. F. C. Macomber as executive officer for the first term) consists of Maj. L. C. Pettit, Capt. W. A. Poirier, and Lt. R. W. Richey. Under the "two-headed" system which in this case works very well, the Academic Division is divided into eight sections and a total of nearly 40 branches which correspond to departments in the usual American civilian organization.

The Science Section of Biarritz American University had, at the close of the first term, a total strength of 70 persons; the Science Section chief, 5 branch heads, 45 instructors, 12 assistant instructors, and 7 secretaries who are British Civilian Volunteers. The personnel of the Section, exclusive of secretarial help, is as follows:

Section office: Stanley A. Cain, chief; *Biology Branch*; Thomas H. Bissonnette, head; Benjamin R. Coonfield, Capt. Cyril J. Corum, Earl A. Dennis, Capt. Alvin R. Grove, Jr., Charles E. Hadley, Walter N. Hess, and Maj. Lincoln C. Pettit, instructors; T/3 Wendell T. Blight, Pfc. Wilbur L. Bullock, Pfc. Ernest Johnson, Cpl. James O. Maher, and Pfc. Marvin C. Martin, assistant instructors; *Chemistry Branch*: Andrew J. Scarlett, head; Maj. Perley D. Baker, Gladstone B. Heisig, Matthew L. Holt, Martin Meyer, Lt. Col. A. G. Siverson, and Lee F. Supple, instructors; M/Sgt. Nevis E. Cook and T/4 David R. Gross, assistant instructors; *Geology Branch*: Jesse J. Galloway, head; Armand J. Eardley and 1st Lt. Gerald M. Stafford, instructors; T/3 Max G. White, assistant instructor; *Mathematics Branch*: Joshua I. Tracey, head; T/Sgt. Elwood F. Arndt, Frank Ayres, Jr., Frederick R. Bamforth, Isaac A. Barnett, Lt. Col. Alonzo C. Cohen, Jr., Pfc. Samuel D. Conte, T/5 Jack C. Gibson, Lester S. Hill, Capt. Andrew O. Lindstrum, Jr., Raymond B. McClenon, Edward R. C. Miles, John H. Neelley, Alfred L. Nelson, 1st Lt. Stephen Oselinsky, Cecil G. Phipps, Joseph C. Polley, Bernhard P. Reinsch, Capt. Walter T. Scott, Charles R. Sherer, Gabor Szego, 1st Lt. Harold E. Temmer, Herbert S. Thurston, Lt. Col. Adlai S. Turner, and Roy M. Winger, instructors; *Physics Branch*: Paul R. Gleason, head; Maj. William M. Barrows, Jr., G. Harvey Cameron, Maj. Sherman W. Eager, Ralph B. Kennard, Wendell H. Kinsey, and Jefferson S. Meares, instructors; Pfc. John S. Winston, assistant instructor.

One question that arises in connection with a temporary institution such as Biarritz American University is that concerning the quality of the instructional staff. The only good answer to such a question arises from a familiarity with performance under a given set of conditions, but certain statistics are suggestive. Leaving out of consideration the 11 assistant instructors who are all military men, comparatively young, and assigned by the Army to BAU for duty, there are 51 "professors" in the Science Section, of whom 34 are civilians and 17 are Army officers and enlisted men. Thirty-nine of the science staff have the doctoral degree and, of the 12 who do not, 8 are military men who for the most part had their graduate study interrupted by the war.

The University of Chicago leads the list of institutions from which the Ph. D. was obtained, with four each in biology and mathematics and one in physics. Harvard, Yale, Cornell, Columbia, and Wisconsin are each represented on the science faculty by three of their Ph. D. graduates. Represented by two Ph. D. graduates each are Princeton, Indiana, Johns Hopkins, Illinois, and Rice Institute, and by one each, Michigan, Minnesota, Ohio State, California Institute of Technology, and the University of Vienna.

The 34 civilians were recruited for service at BAU directly from academic institutions in the States. Eleven of the military men are also on leaves of absence from similar institutions, and only 6 of the younger men are without school connections at home. The 51 professors of the BAU Science Section held various academic ranks in 42 different institutions before entering Army service. Two-thirds of them hold the rank of professor at their parent schools, one-half of these being also department heads. Schools represented on the BAU science faculty include: Alabama Polytechnic Institute, University of Alabama, American University, Arkansas Polytechnic College, Brooklyn College, Carnegie Institute of Technology, University of Cincinnati, Colgate University, Connecticut College, Dartmouth College, Dickinson College, Duke University, Florida Southern College, Florida State College for Women, University of Florida, Grinnell College, Hamilton College, Hunter College, Illinois Institute of Technology, Indiana University, Leland Stanford University, University of Michigan, University of Minnesota, Montclair State Teachers College, North Carolina State College, Northwestern University, Norwich University, Ohio State University, Oklahoma A and M College, Pennsylvania State College, University of Tennessee, Texas Christian University, University of Texas, Trinity College, Wabash College, University of Washington, Washington and Lee University, Wayne University, Western Reserve University, Wilson Teachers College, and Yale.

It is apparent from the foregoing statistic that the faculty of BAU (and the Science Section is perhaps typical of the whole) has an average academic qualification that excels that of the usual institution of its size in the States. A partial explanation is that the civilian recruits had to be at least 42 years of age and to have established reputations as successful teachers. A second explanation of the excellence of the BAU faculty is the care and good judgment of the military men and their civilian advisers who have worked since shortly after V-E Day on the problem of personnel procurement.

Another question in connection with the personnel problem is that of the willingness of the teachers to work in war-torn Europe and of the colleges and universities to release much-needed staff members. The principal answer to this question, I believe, also lies with the good efforts of members of the procurement staff, who not only made work with the American Army universities attractive, but who also convinced the candidates of the soundness and worth of the program. V-E Day was passed, and V-J Day was in the uncertain future. Teachers knew something of the conditions of war and the need of the soldiers for the type of transitional experience from war to civilian life which good American schools in Europe could provide, and several of them had served in World War I and taught in Army schools at that time. Many of them had taught recently in the Army Air Forces and Navy college training programs and desired to do more for the war effort and the soldiers.

CURRICULA

The 37 course offerings in science for the second term, which include only minor changes from the first term, are as follows:

Biology Branch: General Biology, Botany I (structures and functions), Botany II (survey), Plant Classification, Bacteriology, Genetics, Zoology, and Physiology; *Chemistry Branch*: Introductory General Chemistry, General Chemistry Review, Qualitative Analysis, Organic Chemistry, and Physical Chemistry; *Geology Branch*: Physical Geology, Historical Geology, Geomorphology, Structural Geology, and Field Geology; *Mathematics Branch*: Intermediate Algebra, College Algebra, Higher Algebra, Plane Trigonometry, Spherical Trigonometry and Astronomy, Plane Analytical Geometry, Advanced Analytic Geometry, Differential Calculus, Integral Calculus, Ordinary Differential Equations, Mathematics of Finance, and Higher Mathematics for Engineers and Physicists; *Physics Branch*: Nature of the Physical World, Introductory College Physics, General College Physics (mechanics, heat, and sound), General College Physics (magnetism and electricity, light, and modern physics), Atomic Physics, Magnetism and Electricity, Mechanics, and the Physics of Weather.

For the first term the Science Section taught 1,805 students in 96 classes with an average class size of less than 19 students. The second term enrollment is 1,946 in 105 classes with an average class size of 18.5.

The normal student load is three courses meeting daily, Monday through Friday. Teaching of three classes is also considered the normal faculty load. In some cases this means 15 contact hours a week, and most classes are rated at 40 contact hours for the eight-week course. In some of the sciences the credit units are increased to 4 and the weekly contact hours to 8 or 10. Two such courses are considered a full load for both students and teachers. Section chiefs and Branch heads carry a reduced teaching load because of their administrative duties. There is an orientation, advising, and counseling system which serves the students at registration and subsequently during the term. The official Faculty Advisers were relieved of teaching one class because of this duty. In general, the advising system has worked well by giving the students every aid while judiciously allowing them freedom and responsibility in determining their selection of courses.

SPECIAL EDUCATIONAL OPPORTUNITIES

Although inadequate on the day of the opening of the first term, classroom and laboratory furnishings were soon available and satisfactory, if not complete, standard, and elegant. A good amount of proverbial Yankee ingenuity went into laboratory improvisation. Ordinary Army supply stocks, sources, methods, and personnel were inadequate to handle the unique and tough problems of academic supply, such as obtaining living organisms and prepared biological materials, chemicals rare in the European Theater of Operations, fossils and rock specimens, apparatus for mechanics, etc. In addition, processing of requisitions, transportation and other delays at first caused serious deficiencies in teaching materials. In some cases exploration and hand processing were quickly learned by the civilian instructors, and, aided and abetted by some officers, they were able to obtain equipment and supplies for biology, chemistry, and physics that never would have been obtained through "channels," or only after long delays. Three instructors, representing chemistry, biology, and physics, spent several days in Germany in the area between Frankfurt and Stuttgart, obtaining useful materials from captured medical dumps; and the physicists were able, by personal visits, to get for BAU many items from Signal Corps depots and other Army sources around Paris and Marseilles. In biology and geology, staff members were appointed collectors and by daily field work were able to obtain from the Basses Pyrénées district many excellent teaching materials. As a matter of fact, the use of such methods is standard at some institutions at home and enhances the value of a course. Textbooks have been a problem in several courses. Usually the books available have been the Education Manuals and Army Textbooks already in ETO. Some classes went through the first term either with no textbook at all or with a limited number on reference in the Library. The Library has steadily increased the number and usefulness of the items it contains. At the close of the first term there was a total of about 7,000 items available for student and staff use.

There are some advantages in the teaching situation at BAU that are noteworthy because they frequently do not exist at home. The biologists have made good use of the seashore, conducting some classes on the beach and obtaining laboratory materials from the sea. They also arranged for generous use of the very excellent local Musée de la Mer, not only for students in biology classes, but also for all members of BAU, with a naturalist-interpreter present as guide one day a week. The shortage or lack of preserved or prepared materials caused a desirable usage of living materials in biology. The geologists also found the Museum useful and have enriched their courses by collection of local rocks, minerals, and fossils. The chemists have utilized local industries by conducting tours to superphosphate and lead-chamber sulphuric acid plants, to open-hearth steel plants, blast furnaces, and coke ovens. In several instances, contacts have been made with French scientists which have resulted in enrichment of the teaching program at BAU. An extraordinarily capable and helpful Visual Aids Branch, attached to the Academic Division, has prepared wall charts and tables, still and working models, and apparatus that equals or excels similar materials available in the States. This Branch has also shown numerous instructional movies for the classes. For example, Biology used 14 different films for a total of nearly 100 runs during the first term. One of the finest and most unusual features of the BAU teaching program is the extensive use of motor transportation. Jeeps, weapons carriers, two-and-a-half-ton trucks, and personnel carriers were made available for staff reconnaissance of the area, collecting, and conducted class trips, both during regularly scheduled class periods and on week ends. During one five-week period about 250 such trips were scheduled, and in one week about 60 such trips went out, approximately 1,000 students being accommodated. In the Academic Division as a whole, the Agriculture, Engineering, and Science Sections were the heaviest users of motor transportation, but Liberal Arts, Fine Arts, Journalism, and Commerce conducted some field trips with such diverse objectives as painting, the study of local flora, Basque villages, power installations in the Pyrénées, and sites of discovery of relics of prehistoric man.

The members of the BAU faculty are receiving beneficial experiences which will be reflected in their professional work and benefit their institutions. Although the course offerings have been mostly at the Lower Division level, there have been some advanced classes with highly qualified and stimulating student personnel. The Faculty has generally been impressed with the earnestness of the soldier students and their ability quickly to make the necessary adjustments from the military to the civilian patterns of thought and behavior. Although most of the soldiers have been away from the classroom atmosphere for from two to several years, they nearly all get back into the swing of it within two weeks. The anticipation of difficult psychological adjustment problems and the extensive planning and worrying on the part of educators at home as to what to do with the returning soldier have been unnecessary except for a very small percentage of men. The BAU teachers, on returning to their parent institutions, will be in an excellent position to assist their colleagues and administrators.

To any professor, whether or not he had been to Europe before, a chance to spend several months in France and, especially, to see firsthand some of the effects of the war and occupation was an inducement to accept the invitation to join the BAU faculty. Furthermore, the travel and foreign experience was to be without financial loss, for the Army contracts were so drawn that the teacher received his base pay plus 25 per cent for overseas duty and subsistence. Firsthand contacts with the French landscape and natural features, with industry and business, with the people and their conditions of life, and with French educators, scientists, and artists, offered the prospective instructor at BAU a strong reason for accepting the academic adventure.

Our military administration has made it possible for many of the professors to have additional experiences of great value to them. Between the first and second terms nearly everyone was allowed to leave Biarritz and to spend a period of approximately seven days on temporary duty at some point of interest. The majority accepted duty at Paris or London, with considerable freedom of movement at their destinations and with transportation and subsistence furnished. Some joined the regular Army tours of Switzerland or took hiking trips in the Pyrénées. One group of professors, as guests of the Ninth Air Force, toured Germany giving a series of lectures to the soldiers on subjects as diverse as the atomic bomb, the future of small business, and the contemporary American novel. Others attended the Congrès de la Victoire of the Association Francaise pour l'Advancement des Sciences. At the time of this writing, plans are being made for an American Week in the Netherlands early in December when about 40 professors from Biarritz American University and Shrivenham American University will deliver over 100 papers on recent advances in their fields. This goodwill congress will help our Dutch friends fill the void produced by more than five years lack of contact with scientific and other developments in the States. Such experiences are of inestimable value to the American educators who participate. They also do much to reassure our European colleagues, who have suffered and lost so much, that there is an internationalism and fraternity of science and scholarship.

The primary objectives of the Army in the establishment of the universities abroad were to develop institutions as nearly as possible like the usual civilian university of the United States to help the soldier awaiting redeployment (to the States or, at that time, to the Pacific Theater) make adjustments to civilian life while spending his time profitably. These objectives, in the opinions of both the students and the faculty, have been attained to a high degree through the institution which is briefly described above, and because of the reasonableness, the common sense, and cooperation of the military and civilian staffs, and the complete academic freedom which the Army had given the faculty. As far as academic credits are concerned, there seems little doubt that registrars will accept the course work done here by the students at its face value. But of far more significance are the wholesome lack of overconcern with credits, the desire to learn for its own sake and prepare for a new life.

Science Legislation

Domestic Control of Atomic Energy

Howard A. Meyerhoff
Executive Secretary, AAAS, Washington, D. C.

From the standpoint of scientific achievement, the war's climax came with the atomic bomb. It was inevitable that such a devastating weapon should arouse mixed feelings of alarm and admiration for the brains which conceived it and for the nation that had the ingenuity to produce it and the audacity to use it—sparingly, but with telling effect.

When the first bomb exploded in New Mexico, it ceased to be the possession of scientists and became the problem of the nation. When the second bomb exploded over Hiroshima, it was no longer a national problem but a matter of international concern. Inevitably the journalists took possession of it, and politicians and statesmen quickly followed suit. The lay public can talk almost as intelligently as scientists themselves on the principles of the bomb and on its potential implications to all mankind.

Legislation designed to develop and also to control the use of atomic energy was inevitable, and three bills have been introduced into Congress with this general purpose. S. 1463 (known as the May-Johnson Bill), S. 1557 (the Ball Bill), and S. 1717 (the McMahon Bill) are now before the Senate, and it is desirable that scientists know not only the provisions of the separate bills, but specifically the points wherein they differ. In so far as scientists are concerned, there are important and serious questions to be faced and to be decided. So powerful a weapon as atomic energy calls for restriction of use, and restriction of use in turn demands certain restrictions upon freedom of research and freedom of publication.

The major differences of opinion among individual scientists and between scientists and members of the Government were featured, with some distortion, in the press when the hearings on the first two of these bills were held. It is not the purpose of this brief article to favor any one of the bills presented here, but rather to offer the readers of *Science* an analysis of the three bills as a basis for the formulation of sound judgment.

Fortunately, such an analysis has been prepared in chart form by Senator McMahon and his staff. This comparative summary is reproduced herewith with the permission of his office.

Comparative Summary of Key Senate Bills
for
Domestic Control of Atomic Energy

S. 1717 (SENATOR McMAHON)	S. 1463[1] (SENATOR JOHNSON)	S. 1557 (SENATOR BALL)
	I. Control of Atomic Energy in General	
Bill incorporates specific policy decisions on nature and extent of Government control. Commission's powers are specifically tailored and limited to fit these decisions.	Bill incorporates no specific decisions on nature and extent of Government control. Commission's powers are adequate, but broad enough to permit the extremes of either too great or too little Government control.	Bill incorporates no specific decisions on nature and extent of Government control. Commission is given authority to ''control'' raw materials, production, and finished active materials with no implementing provisions.
	A. *Production of Fissionable Materials*	
Commission to have monopoly of production of fissionable materials. Production in minor quantities incident to research permitted subject to frequent inspection and reports.	Commission permitted to authorize private production of fissionable materials.	Commission permitted to authorize private production of fissionable materials.

---

[1] The so-called "May–Johnson Bill" as introduced. After amendment by the House Military Affairs Committee the bill was reported out as H.R. 4566.

S. 1717	S. 1463	S. 1557
	B. *Fissionable Materials*	
Exclusive Government ownership of fissionable materials but to be made available for research and licensees (see E) for use in devices.	Private ownership of fissionable materials permitted. Commission may permit *any* private use of fissionable materials (see E).	Private ownership of fissionable materials permitted. Commission may permit *any* private use of fissionable materials (see E) but required to allocate for peaceful and military uses.
	C. *Source Materials*	
Commission licenses movement of ingredients essential for production of fissionable materials to assure adequate supplies and prevent diversion inconsistent with national welfare. Commission has authority to buy or condemn.	Commission's only authority over source materials is power to buy or condemn.	Production, sale or allocation of source materials unlawful unless authorized by Commission. Commission to allocate for peaceful and military uses.
	D. *By-product Materials*	
Commission shall distribute for constructive uses, giving preference to *research and medical therapy.*	Commission may dispose of by-product materials as it sees fit.	See B. By definition, by-product materials are treated same as fissionable materials.
	E. *Atomic Energy Devices* (i.e. *devices utilizing fissionable materials)*	
Use not permitted until after report to and opportunity for Congress to legislate on the basis of specific knowledge of utility, practicability, and consideration of economic, political and social implications of marketing such devices. Licensing of atomic energy devices for private use permitted if Congress fails to act in 90 days but such licenses may not extend to the production of fissionable materials.	Commission has broad authority to license any private use (including power, heat, transportation, when and if feasible), whether or not fissionable materials are produced incident to such use.	Operation of private devices not prohibited unless pursuant to authority to "control." Commission has broad authority to license any private use, whether or not fissionable materials are produced incident to such use.
	F. *Patents*	
1. All private patent rights on production processes must be sold to Government (see A). 2. Private patents on devices utilizing fissionable materials permitted subject to compulsory licensing at reasonable royalty rates determined by Commission. (Subject also to E above.)	No specific provision on patents. Commission may buy or condemn private patents or may permit their restrictive use.	No specific provision on patents unless within general authority to "control" production and "finished active materials."
	II. STIMULATION OF RESEARCH AND DEVELOPMENT	
Research responsibility and powers of Commission include social, political and broad economic effects of atomic energy developments, as well as military, industrial and scientific research aspects.	Research responsibility and powers of Commission limited to military, industrial, and scientific research.	Research responsibility and powers of Commission limited to atomic energy research.
	A. *Independent Research*	
1. No license or permission from Commission required to do research. Private research must comply with safety regulations, and be subject to inspection.	1. If research involves release of atomic energy in amounts militarily or industrially significant, permission from Commission must be obtained and research will be subject to conditions prescribed by Commission.	1. License required for research; may be issued only to qualified organizations. Shall be revoked if research is not competent or wasteful of materials. Conduct of research must comply with safety regulations.
2. Commission shall give preference to independent research in allocating fissionable materials (see I B).	2. Commission has authority to license the use of Commission-owned fissionable materials for private research (see I B).	2. Commission shall allocate fissionable materials for private research to competent applicants upon proof that purposes of research are consistent with Act.
3. Provides for grants-in-aid, contracts and other forms of assistance.	3. Provides for grants-in-aid, loans and other forms of assistance.	3. Provides for grants-in-aid, contracts and other forms of assistance.

B. *Dissemination of Information*

S. 1717	S. 1463	S. 1557
1. ***Basic scientific information*** is free of restriction.	1. & 2. Commission given full authority to issue restrictive regulations (over and above Espionage Act) on dissemination of scientific information, with criminal penalties for violation.	1. No security regulation to be issued affecting fundamental research.
2. Commission is directed to provide for dissemination of ***related technical information*** with utmost liberality. Commission by regulation may free such information from all restriction, or, with approval of President, may restrict its dissemination on finding that Espionage Act is applicable.		2. Security regulations on military research and military utilization may be issued by Secretaries of War and Navy, and approved by Commission. Criminal penalties for violation.
3. Scientists work under Espionage Act as in peacetime and may, if they desire, obtain clarification of the Espionage Act by action of Commission. Subject only to regular criminal prosecution under Espionage Act.	3. Commission may direct the dismissal of any scientist from public or private employment if Commission believes him to have violated security regulations, without regard to criminal prosecution or conviction therefor.	3. Scientists work under Espionage Act and security regulations issued under 2.

C. *Government Research*

S. 1717	S. 1463	S. 1557
Commission authorized to conduct any type research related to purposes of Act. Takes over Manhattan District Property.	Commission authorized to conduct research but is directed to make maximum use of private and other Government research facilities. Takes over Manhattan District Property.	Commission authorized to develop its own facilities for research only if existing private and Government facilities are inadequate. Takes over Manhattan District Property.

III. INTEGRATION WITH FOREIGN POLICY IN GENERAL

S. 1717	S. 1463	S. 1557
Bill emphasizes peacetime uses of atomic energy. Provides affirmatively for dissemination of information to create atmosphere of international confidence. Provides for anticipation of long-range developments through social, political and economic studies. Provides for all-civilian administration of the Act.	Bill emphasizes military uses of atomic energy. No provision for dissemination of information other than restrictive security regulations. Permits military membership on Commission and members of armed forces on active status to serve as Administrator and Deputy Administrator.	Bill contains emphasis on neither military nor peacetime aspects. Provides for free dissemination of fundamental scientific information and limits security regulations to the military field. Provides for two military members of Commission.

A. *Bombs and Military Weapons*

S. 1717	S. 1463	S. 1557
1. Manufacture permitted only if express approval of President obtained for each quarter. No private or military manufacture permitted.	1. No specific provision on bomb production. Commission may manufacture as it sees fit, or authorize manufacture by the military or by private concerns.	1. No specific provision on bomb production. Uncertain whether Commission permitted to manufacture but no limitation on manufacture by Armed Forces.
2. Commission has custody of all bombs and military weapons subject to direction of President.	2. No specific provision on custody of bombs. Either the Commission or the Armed Forces may have custody.	2. No specific provision on custody of bombs.
3. Commission may not conduct research in military uses of atomic energy contrary to international agreement.	3. Commission is directed to conduct research for the exploitation of atomic energy for military purposes. No reference to international agreement.	3. Army and Navy conduct military research with Commission serving in advisory role. No reference to international agreement.

B. *Preservation of Freedom to Act Internationally* (See A *re* Bombs)

S. 1717	S. 1463	S. 1557
1. Government monopoly of production prevents creation of private interests which might be inconsistent with or deter international agreement.	1. Private interests in production of fissionable material may be created.	1. Private interests in production of fissionable material may be created.
2. Prohibition of atomic energy devices (see I E) prevents private activities which might be inconsistent with or deter international agreement.	2. Private operation of devices (power plants, etc.) permitted.	2. Private operation of devices permitted.

C. *International Control of Fissionable Materials*

S. 1717	S. 1463	S. 1557
1. Private export or import of fissionable materials forbidden.	1. Commission may permit private export or import of fissionable materials.	1. No specific provision on export or import of fissionable materials.
2. Private participation in production of fissionable materials in another country forbidden.	2. No specific provision on foreign production of fissionable materials.	2. No specific provision on foreign production of fissionable materials.

S. 1717	S. 1463	S. 1557
	IV. ORGANIZATION A. *Structure*	
Bill creates five-man Commission, all members serving full-time. Four subordinate Directors to have functions as assigned by Commission. Express provisions against conflict of interests.	Bill creates nine-man Commission, all members serving on a part-time basis. Administrator and Deputy Administrator. Administrator given powers fully as broad as those of Commission.[3] Commission members exempted from statutes prohibiting dealings with Government by Government employees.	Bill creates nine-man Commission consisting of five Cabinet members and four public members. Public members serve on a part-time basis. Administrator and Deputy Administrator function under direction of Commission.
	B. *Appointment and Removal*	
1. Members of Commission and four Directors appointed by President.	1. Members of Commission appointed by President. Administrator and Deputy Administrator appointed by Commission.	1. Four public members of Commission appointed by President. Administrator and Deputy Administrator appointed by Commission.
2. All must be civilians.	2 All may be members of the Armed Forces.	2. Neither public members nor Administrator nor Deputy Administrator may be members of the Armed Forces.
3. All serve at pleasure of President.	3. Members of Commission appointed for nine-year terms. Removable only for cause.	3. Public members of Commission appointed for six-year terms. No restrictions on President's removal authority.

[3] H.R. 4566 makes Administrator clearly subject to directions of Commission.

Association Affairs

The Science Writers Annual Award

The George Westinghouse Science Writing Award Fund, to give national recognition to newspaper writers and newspapers contributing most to better popular understanding of the achievements of science and technology, has been announced by Dr. F. R. Moulton, permanent secretary. The fund has been provided by the Westinghouse Educational Foundation, which is supported by the Westinghouse Electric Corporation, in commemoration of the 100th anniversary of the birth of George Westinghouse. The fund will be administered by the AAAS, Dr. Moulton said, "to help develop closer cooperation between scientists and news writers in keeping the public informed of scientific developments which more and more affect our lives in this atomic age."

The fund provides two annual awards: (1) a cash award of $1,000 to a newspaper writer for outstanding science reporting of the year; (2) a citation to the newspaper whose science news coverage in the preceding year is adjudged most complete and authoritative and most interestingly presented. In addition, there may also be awarded at the direction of the Awards Committee special citations in recognition of distinguished service in science journalism.

The first annual awards, covering the year 1946, will be made at the winter meeting of the AAAS in December 1946. Details of the judging and presentation of awards will be made at the spring meeting of the Association in St. Louis, 27–31 March. Members of the Awards Committee which will administer the fund include: Dr. Anton J. Carlson, chairman of the Executive Committee; Dr. Otis W. Caldwell, general secretary; Dr. Moulton; Watson Davis, director of Science Service and a past president of the National Association of Science Writers; Robert Potter, science editor of the *American Weekly* and a founder of the National Association of Science Writers; Dr. Morris Meister, principal of the Bronx (New York) High School of Science; G. Edward Pendray, public relations counsel; and James A. Baubie, public relations director of the Westinghouse Electric Corporation.

"Heretofore," said Dr. Moulton, "prizes, medals, and citations in the fields of science have been given only for distinguished scientific researches or for contributions to scientific theories. The science writing award is something different from previous recognitions of contributions to the advancement of science. It will be an award for superior science writing for lay readers."

Technical Papers

Sterility Induced in Growing Rats on a Tryptophane-deficient Diet

William F. Keller
University of Maryland

While conducting experiments to determine the rate of recovery[1] of growing rats after being fed various deficiency diets, the author discovered somewhat different results in the case of the tryptophane-deficient animals. When they reached maturity, all the rats who had lacked this essential amino acid in their diet were found to be sterile. Since only one brief reference to such an occurrence could be found, and this with regard to male rats only, a further study was instituted, and its results are reported herein.

Throughout the entire project, albino rat pairs ranging in age from 28 to 48 days were used for experimental subjects, and in each case a pair of litter mates was used for controls. The experimental animals were fed a deficient diet[2] similar to that of Albanese and Buschke (*1*) for periods ranging from 3 to 18 days and then returned to the colony diet[3] which was fed the controls throughout the investigation.

In all cases the original matings were observed until the animals were at least 100 days old, by which time all but one of the control pairs had produced a litter. Since there had been no evidence of any sexual interest between the experimental pairs during this period, they were separated and mated to controls which had been proven fertile. The 38 deficient control crosses were observed for 90 days, and since there was no evidence of coitus, all but 10 of the matings were sacrificed and their gonads and pituitary removed for histological observation. The remaining animals were observed for an additional 60 days, and when they too were shown to be sterile, they were sacrificed as were the others.

The observations reported here show rather conclusively that growing rats, when fed a diet lacking tryptophane, even for as short a period as 3 days, manifest sterility, and that both sexes are affected similarly. This, furthermore, lends support to the belief that this amino acid has numerous specific actions in addition to aiding in the synthesis of body proteins. Further observations should show whether this specific action is on the gonads directly or through some other organ indirectly.

Reference

1. Albanese, A. A., and Buschke, W. *Science*, 1942, **95**, 585.

---

[1] Rate of recovery as used here refers to the time necessary for a deficient animal, after being returned to a normal diet, to equal the relative length and weight of its litter mates reared entirely on the normal or control diet.

[2] The exact composition of the diet was as follows: potato starch, 40 grams; bacto-gelatine, 30 grams; sucrose, 10 grams; olive oil, 10 grams; castor oil, 5 grams; and basic salt mixture, 5 grams. The salt mixture was composed of: NaCl, 1.78 grams; $MgSO_4$, 5.45 grams; K_2HPO_4, 9.54 grams; $CaH_4(PO_4)_2 \cdot H_2O$, 5.40 grams; Na biphosphate, 3.47 grams; Fe citrate, 1.18 grams; Ca lactate, 13.00 grams.

[3] The colony, or control, diet consisted of Friskie's Dog Food supplemented twice weekly with lettuce leaves.

The Effect of Environmental Temperature on Mouse Susceptibility to Poliomyelitis Virus

D. Frank Holtman
University of Tennessee

Environmental temperatures have been shown experimentally to play a significant role in modifying resistance to infectious disease of bacterial origin (*1*); hence, an investigation was made to determine whether environmental temperature affects the course of a virus disease, such as poliomyelitis. The virus was obtained from Dr. John F. Toomey, Western Reserve University, Cleveland, Ohio.

For the test, three groups of mice were acclimated to temperatures of 13° C., 22° C., and 32° C. Although referred to as a group, the mice held at 13° C. were kept in small cages, six to a cage, to prevent too much huddling. Three-week-old mice of relatively uniform weight (13–15 grams) were employed, and each group was held at its respective temperature for three weeks. Thus, the mice were six weeks old when finally tested for susceptibility to the virus.

After becoming acclimated to a given temperature, all the mice adapted to that temperature were subdivided into six groups. Three of the subgroups received intracerebral injections of 0.05 ml. of a 3-per cent infected brain-cord suspension. The remaining subgroups served as controls. One infected and one control group were kept at each of the three experimental temperatures, regardless of the temperature to which they had been originally adapted.

The mice acclimated to 13° C. and held at that temperature after inoculation never showed symptoms of paralysis in less than 11 days, with 13 days being required to establish 50-per cent mortality. In contrast to this, mice adapted to 22° C. and held at that temperature after injection showed 50-per cent mortality at the end of seven days, and mice acclimated to and held at 32° C. began showing symptoms and dying as early as the fifth day. The mice originally acclimated to 13° C. and kept at 22° and 32° C. after injection showed greater susceptibility than those allowed to remain at 13° C. Conversely, mice originally adapted to 22° and 32° C. exhibited a greater resistance to infection, as indicated by a prolonged incubation period, when kept at 13° C. than when held at the temperatures to which they had first been acclimated (Table 1). Brain-cord material recovered by sacrificing some of the infected mice and treated with a known poliomyelitis virus neutralizing serum lost its infectivity.

TABLE 1

THE EFFECT OF ENVIRONMENTAL TEMPERATURE ON SUSCEPTIBILITY OF WHITE MICE TO POLIOMYELITIS VIRUS

Temperature to which mice were acclimated for 8 weeks prior to inoculation	Temperature at which mice were kept after inoculation with virus, numbers injected, and days elapsed before appearance of symptoms and mortality in 50 per cent of each group*					
	13° C.		22° C.		32° C.	
	No. mice	Incubation	No. mice	Incubation	No. mice	Incubation
13° C.	48	13 days	48	9 days	12	7 days
22° C.	48	9 days	48	7 days	12	6 days
32° C.	12	9 days	12	6 days	12	5 days

* All experimental groups were controlled with noninfected mice that received the same environmental treatment.

Since the experiment was repeated several times, mice from the same source were not always available. This, however, did not appear to alter the course of infection. Other factors, such as weight, feed, and dosage of virus were kept relatively constant. Hence, environmental temperature must be considered as the major factor contributing to the variation in incubation periods.

In view of the fact that metabolic rates tend to increase upon exposure to cold and decrease at higher temperatures, the data collected in this investigation could be interpreted as indicating the rapid growth of the virus, and the resulting symptoms of disease to be dependent upon a disturbance of the normal metabolic rate of the host. If the data under discussion could be applied to the human, one might assume that among occupants of temperate zones the shift from cool temperatures of the spring to the heat of summer creates an added susceptibility, not only through much greater opportunity for exposure to virus, but also through a decrease in the metabolic rate of the host, a condition possibly favoring rapid growth and spread of virus through the tissues of the host. Likewise, increases in the metabolic rate brought about with the onset of cooler temperatures of the autumn might interfere sufficiently with virus growth to lengthen the incubation period and permit certain infected individuals to develop resistance before exhibiting definite symptoms of poliomyelitis. It might even account for sporadic cases of the disease occurring in winter as a result of late summer infection and a prolonged incubation period. In advancing this concept, one would have to assume the need for a relatively gradual environmental temperature change, since work done on monkeys (*2*) has shown that the shock induced by sudden exposure to extreme cold after infection actually increases susceptibility, as well as the severity of the disease.

If one were to accept the thesis that a decrease in the metabolic rate creates an optimal condition for the growth of the virus and thereby increases host susceptibility, it would be difficult to explain why poliomyelitis is not more prevalent in the tropics and also why adults with their lower metabolic rates are not more highly susceptible than children. While it is true that poliomyelitis occurs in tropical regions, it seems seldom to assume the epidemic proportions so common in temperate zones during summer months. With regard to the susceptibility of children, it must be borne in mind that poliomyelitis is most prevalent in the five to nine age-group. These are not only the years when exposure may be relatively easy, but also constitute the period when the metabolic rate is declining rapidly after reaching a peak at approximately age five. Thus, the possibility of a "critical" or optimal metabolic rate of the tissues for virus growth being more readily obtainable between the ages of five and ten cannot be ignored. Even though any change in metabolic rate of the tissues as a result of external temperature variations may be very slight, possibly only that slight disturbance of normal metabolism is required to promote increased susceptibility or resistance. In other words, seasonal temperature fluctuations and the resultant metabolic disturbances, particularly toward a decrease in the metabolic rate, might be considered as being more conducive to susceptibility than prolonged exposures to relatively high, yet stable, temperatures.

References

1. MILLS, C. A., and SCHMIDT, L. H. *Amer. J. trop. Med.*, 1942, **22**, 655.
2. MILZER, ALBERT, LEWIN, PHILIP, and LEVINSON, SIDNEY. *J. Bact.*, 1943, **45**, 78.

Scanning Science—

The so-called Liebig's condenser was not devised by Liebig, but by a student of medicine at Göttingen, Christian Ehrenfried Weigel. Liebig never claimed to be the inventor of his condenser, but describes it in his *Handbuch* (1843) as "der Göttlin'sche Kuhlapparat," while Göttling in his *Almanach* (1794) rightly ascribes its invention to Weigel, who was then professor of botany and chemistry at Greifswald.

—28 February 1896

News and Notes

Dr. Carl M. Stevens, formerly research associate in the Department of Biochemistry, Cornell University Medical College, is now assistant professor of biochemistry in the Department of Chemistry, State College of Washington, Pullman.

Dr. Harry W. Karn, recently released from active duty in the Navy and formerly assistant professor of psychology at the University of Pittsburgh, has been appointed assistant professor of psychology in the Division of Humanistic and Social Studies at the Carnegie Institute of Technology, Pittsburgh.

Prof. Raymond Delaby, general secretary of the Société Chimique de France, has been appointed to the general secretaryship of the International Union of Chemistry, succeeding Dr. Jean Gerard, whose term of office has expired. Prof. Delaby's address is 4, Avenue de l'Observatoire, Paris (6).

J. Casper Schwarz has resigned as assistant superintendent of Lambert Pharmacal Company to open a private consulting service to the cosmetic, perfume, and allied trades. Offices will be temporarily maintained at 4 Wakefield, Ladue, St. Louis County 17, Missouri.

Dr. John Romano, psychiatrist of the University of Cincinnati College of Medicine and director of the Department of Psychiatry, Cincinnati General Hospital, has accepted appointment as professor of psychiatry at the University of Rochester School of Medicine and Dentistry.

Announcements

The Manchester Guardian reports that J. D. Bernal addressed the Royal Institution in Manchester on 23 November 1945. Mr. Bernal said: "One of the characteristics of the new age is that you cannot take a step in any social or political scheme without involving yourself in highly technical and scientific questions. It does not mean that scientists claim to be the Government or to have any other statutory position. It only means that government and administration are impossible unless they are thoroughly scientific, in the sense of having people in control who know what they are doing. We are very far from that position today. But it is coming and it is one of the duties of the scientist to point out that this process must go on very rapidly if we are to escape in this country the position of being relegated to a relatively barbarian status."

The Department of Physics, University of Delaware, has recently received as a gift a Westinghouse mass spectrometer, valued at approximately $10,000, according to Dr. Vincent E. Parker, acting head of the Department. The far-reaching expansion of its research program in atomic physics which is planned by the Department will soon be greatly accelerated through the construction of a new $375,000 Physics Building, made possible through the generosity of the late Mr. H. Fletcher Brown, a trustee of the University. Research will be conducted in the fields of isotope separation and tracer research, using both stable and radioactive tracer elements. In addition, the mass spectrometer will be used in a program of cooperative research with the Department of Chemistry and with the Division of Chemical Engineering.

The University of Maryland has announced an additional gift of $800,000 from the Glenn L. Martin Company for its aeronautical engineering school. This gift supplements $1,700,000, given to the University by the Martin Company on 16 December 1944. The two gifts are to be used to establish the Glenn L. Martin College of Engineering and Aeronautical Sciences. The State of Maryland has appropriated an additional $750,000 for the same purpose.

Iowa State College has announced the establishment of a Tropical Research Center in Antigua, Guatemala, after two years of corn research and survey work by college plant and administrative specialists in Central America. Construction has started on the physical plant, and it is expected to be ready for operation by 1 July of this year. Research will be done there, and a limited number of graduate and undergraduate students will go to the tropics to study at the center. Research work will relate to the broader aspects of agriculture and the natural sciences, with the initial emphasis on maize and other plants known to be native to southern Mexico and Central America. The College will maintain a resident director and a small staff at the center during most of the year. This move by the College was made possible in part by a grant for basic research on maize and other cultivated crops by the May Seed and Nursery Company of Shenandoah, Iowa.

In establishing the center, the College is cooperating with the Hacienda Company of Guatemala City and the Guatemalan Ministry of Agriculture. The Hacienda Company is providing buildings to house the activities of the center and lands to be used for experimental plots, testing grounds, and gardens.

The Clinical Fellowships in Medicine offered by the American College of Physicians to provide further training for returning-veteran medical officers, are nearly exhausted. Because of the large number of applications on hand and pending, no further applications will be accepted after 1 February 1946 by the Office of the Educational Director, 4200 Pine Street, Philadelphia 4, Pennsylvania.

The Quarterly Review of Pediatrics is a new abstract journal published by the Washington Institute of Medicine, 1720 M Street, N.W., Washington 6, D. C. Dr. Irving J. Wolman, Philadelphia, is editor. The Editorial Board consists of Drs. Allan M. Butler, Daniel C. Darrow, Ethel C. Dunham, Harold F. Faber, Sidney Farber, Robert L. Gross, Clifford G. Grulee, Henry F. Helmholz, Sam Z. Levine, Hugh McCulloch, Donovan J. McCune, Irvine McQuarrie, Mitchell I. Rubin, Milton J. E. Senn, Joseph Stokes, Jr., Frederick F. Tisdall. The first issue will appear in February 1946. *The Quarterly Review of Pediatrics* plans to survey the current medical literature of this country and abroad and to abstract "as promptly as possible all articles of significance which deal with disease conditions, health, growth, and mental welfare, from infancy through adolescence."

The John Wallace Dallenbach Fellowship in Psychology, a graduate fellowship in memory of John Wallace Dallenbach, former Cornell student killed in action in 1944, has been established at Cornell University. The fellowship, applications for which will be accepted next fall, will provide up to $800 per year in addition to free tuition and may be held one year by a graduate student working in the field of experimental psychology. John Dallenbach was the son of Prof. and Mrs. Karl M. Dallenbach of Ithaca. He was but a few weeks away from his doctorate in psychology at Harvard when he entered the Service.

The Winthrop Chemical Company has extended for another two years its fellowship for the training of medical graduates in the teaching and research of pharmacology at the Stanford University School of Medicine, San Francisco.

Union College, Schenectady, has been given $10,000 by an anonymous donor to endow an annual full-tuition scholarship in chemistry.

The Association of College Geology Teachers held a meeting in Pittsburgh on 28 December during the meeting of the Geological Society of America. The conference in the GSA on training in geology, sponsored by Prof. C. R. Longwell, stimulated interest in the work of the Association, and several requests for membership were received. Any others interested may address the secretary, Miss Katherine Greacen, Hunt Oil Company, Midland, Texas, or the president, Dr. Percival Robertson, Elsah, Illinois.

New research laboratories will be erected on a 260-acre tract halfway between Akron and Cleveland near Brecksville, Ohio, by the B. F. Goodrich Company. The original research laboratory, first in the rubber industry, was established in 1895 in Akron. The outstanding characteristic of the new laboratories will be the adaptability for rapid conversion from one type of work to another. Removable partitions, interchangeable fixtures, and a wide variety of special services will be employed. "It will be possible to change the whole interior arrangement of most of the buildings overnight. We can be engaged in extensive carbon black research one day in a chosen space and within 48 hours be switched over to research on textile fibers, fine films, or plastics in the same laboratory location," Dr. Howard E. Fritz, director of research, said in illustration. The building site was chosen primarily because of its freedom from dust, cross-country electric lines, vibration, and noise. Quarantining of vibration so that the most delicate operations can be carried out has been a special objective, accounting for the separation of the laboratories into five buildings and removal of the whole research project from proximity to any industrial or manufacturing operations. At the outset of operations in the research center the staff will consist of 220 to 250 persons.

A Sociedade Brasileira de Geologia was founded on 27 December at a meeting of Brazilian geologists held at the University of São Paulo, under the auspices of the Departments of Geology and Mineralogy of that University. Prof. Reinaldo Saldanha da Gama, head of the Department of Mineralogy and Petrography, presided, and Dr. Josué Camargo Mendes, assistant professor of geology and paleontology, served as secretary of the organization meeting. Profs. Saldanha da Gama; Octavio Barbosa, Cathedrático de Geologia, Escola Politécnica, University of São Paulo; Kenneth E. Caster, head of the Department of Geology and Paleontology, University of São Paulo; Djalma Guimarães, Cathedrático de Geologia, School of Mines, Ouro Preto; and Othon Leonardos, of Rio de Janeiro, were elected original fellows (socios efectivos) and were charged with the responsibility of selecting fifteen others. All subsequent fellows and members will be elected by the fellowship. Through the kindness of Dr. Jorge Americano, rector of the University of São Paulo, adequate private funds were secured to cover the costs of organizing the society and preliminary plans for a serial publication in geology. The first official meeting of the society will be held in late

February for the adoption of a Constitution and By-laws now being prepared by a committee comprised of Profs. Rui Ribeiro Franco, Rui Ozorio de Freitas, and Fernando F.M. de Almeida, all of the University of São Paulo.

A new series of research positions designed to make science as a career as attractive as the administrative field in industry has been announced by the Technical Division of the Rayon Department of E. I. du Pont de Nemours & Company. The new classifications, which are open to chemists, engineers, and other technically trained employees demonstrating unusual scientific ability, are specified by the titles of "junior research associate," "research associate," and "senior research associate." Salary rates correspond to those for supervisors, managers, and assistant research directors. Dr. E. B. Benger, manager of the Technical Division, has named three members of his staff to the new classifications. Dr. W. E. Roseveare, research supervisor in charge of the basic research group of the Viscose Rayon Research Section at the Spruance Plant, Richmond, Virginia, and Dr. E. F. Izard, Pioneering Research Section at the Yerkes Plant, Buffalo, New York, were appointed research associates. Dr. E. V. Lewis of the Nylon Research Section, Wilmington, became a junior research associate.

Senior research associates will be chosen from men of long service, distinguished scientific attainments, and high creative potential, with capabilities for originating, organizing, and conducting their own research programs. They will have substantial freedom in selection of work and in the selection of assistants. In addition, they will be encouraged to attend any scientific meetings in which they are professionally interested; to contact other laboratories and workers, both in and outside the company, and to publish scientific papers. As a general rule, research associates will concentrate in a single field and will have considerable latitude for exploratory work in unpredictable directions. The plan will roughly double the number of promotions toward which scientists in the Technical Division of the Rayon Department can aspire. Appointments are to be made gradually and only after men have qualified for an appropriate classification.

The Board of Regents of the State College of Washington has announced the establishment of the Washington State Institute of Technology and the Institute of Agricultural Sciences, as components of a far-reaching program of the State College in cooperation with the state-wide industrial and agricultural development program of the State of Washington. This announcement, of special interest in the Pacific Northwest, follows the completion of surveys undertaken by the Board of Regents during the past several months.

The Washington State Institute of Technology includes the College of Engineering, School of Mines, Engineering Experiment Station, Mining Experiment Station, State Electrometallurgical Laboratories, and the Division of Industrial Research and Extension, recently established at Washington State College under a broad charter and liberal grant from the State legislature last spring. The Board of Regents also authorized expansions in the scope of engineering instruction and research, including atomic power engineering. Dr. Paul A. Anderson, chairman of the Department of Physics, has been designated as acting director of the Institute of Technology pending the expected early selection of a permanent director, and Dr. H. E. Culver, chairman of the Department of Geology and former state supervisor of geology, as acting dean of the School of Mines and Mineral Industries. R. D. Sloan continues as dean of the College of Mechanic Arts and Engineering; Homer J. Dana, as head of the Engineering Experiment Station; and E. B. Parker, as director of the Division of Industrial Research and Extension.

The integration of the services of the State College in the Agricultural Sciences follows the recommendations of the dean of its College of Agriculture, E. C. Johnson, who continues in that capacity but requested to be relieved of the administrative responsibilities as director of the Experiment Station as of 1 January 1946 on the completion of 27 years in that position. The Institute of Agricultural Sciences will be headed by Dr. J. C. Knott as director and Dr. Mark Buchanan as vice-director in charge of Agricultural Research and Extension and director of the Washington Agricultural Experiment Stations. The Institute is expected to include, in addition to the College of Agriculture and the Experiment Stations, the Agricultural Extension Service, to be headed by E. V. Ellington, now vice-director of the Agricultural Experiment Stations; the College of Veterinary Medicine, headed by Dr. E. E. Wegner as dean; and, in the College of Home Economics, headed by Dr. Velma Phillips as dean, the research and extension activities pertaining to the Agricultural Sciences or supported by Federal and State Agricultural Experiment Station and Extension funds. Superintendent J. W. Kalkus, of the Western Washington Experiment Station, continues as vice-director of the Agricultural Experiment Station, of which Dr. S. P. Swenson, associate professor of agronomy and genetics, has been named as assistant director. These assignments were effective 1 January 1946 and will be completed as promptly as the necessary arrangements can be made.

At the same time the Board of Regents announced that, effective 1 January 1946, the general salary scale of the teaching faculty of the State College of Washington has been advanced, and that, with the exception of the research, extension, and administrative staff, the regular annual service period of members of the teaching faculty will hereafter be on the basis of 9½ months in place of the customary 11-month basis. It is expected by the Board of Regents that this arrangement will enable members of the faculty to engage more widely than heretofore in studies in other institutions, in travel, in cooperation with various industries and lines of commerce in the Pacific Northwest, and in professional consulting services, as well as in researches in the laboratories and libraries of the State College.

Conditions Abroad

Dr. Reinhard Dohrn, of the Statione Zoologica, Naples, has sent word to his friends in this country that the laboratory is becoming more active from month to month. He writes that "the fact that the Italian National Research Council chose the Station for establishing a 'Centro di studio per la Biologia' has helped very much to revive research life in the Institute. The group of research students who have been working with us since July acts as a catalyst in the recovery of the Station. In the same measure, however, as the activity of the laboratory increases, we feel more and more the isolation we are still living in, and the need of interchange abroad. We feel it all the more, as international contact was always a fundamental factor in the Station's life. The great problem here now is the want of many of the things one needs in normal laboratory activity. The common laboratory materials are either unattainable here, or at shocking black market prices. Above all, of course, the need of the recent literature is felt. So far, however, the existing trade and money exchange restrictions make it impossible to cover our needs by purchasing from abroad in the ordinary way. We have come to an arrangement with Switzerland by which the help they want to give us is offered in the form of goods if we choose. Thus, the money which they grant for the Table rent is kept at the disposal of the President of the Naples Table Committee, Prof. Baltzer, and is used in paying for the Swiss periodicals we subscribe to, and for the laboratory materials which we may order there. We came to this agreement to expedite recovery and to avoid the wasting of money on the black market here. The Legation very kindly agreed to help in the transportation. A similar arrangement is under way for the Table grant from Sweden (Profs. Runnström and Hörstadius). Since there are many American periodicals which we very badly need, and also laboratory equipment, I am wondering whether some sort of arrangement of that kind could be found for temporarily solving the problem of bringing up to date our library as far as American literature is concerned and eventually filling up gaps in our equipment. This would be for the Institute the first and most important step in becoming again an efficient international research center."

Prof. E. Fauré-Fremiet, Laboratoire d'Embryogenie Comparée, Collège de France, Paris, V^me^, France, has written by air mail to Profs. Robert Chambers and Morris Harnly that he is in great need of reprints and books published since 1939. At the moment he is preparing a monograph on the cell and requests from his American friends and colleagues reprints bearing especially on the fields of cytology, protozoology, and embryology. It is requested that scientists having such material mail it directly to him at the above address.

A letter regarding Japanese ichthyologists, dated 19 December 1945, has been received by Dr. Carl L. Hubbs, Scripps Institution of Oceanography, University of California, La Jolla. The letter follows verbatim:

> How do you getting on during the war. Japan is quite defeated. Our Research Institute of Natural Resources and my home were destroyed on the night of 25th May of this year. But now we have new building to constitute the organization of our institute by the help of Maccasa. I am now connecting with the Fisheries Section of Natural Resources of Maccasa General and meeting Mr. J. L. Kask and J. Janssen for the fisheries of Japan. I hope you will come soon again to Japan and work together with us on Japanese fishes. Mr. [Katsuzo] Kuronuma is sick now but soon be better. Mr. [Kiyomatsu] Matsubara is a Professor of Fisheries Institute and carrying the study of fishes. At present we are very trouble to get the food in every day but must continue our scientific work as we could. In Japan it is the most important fact to study the utilization of Natural Resources. For that purpose, our institute must be developed in future. Mrs. Hubbs and your family are quite well? My wife and father died during the war and now I have five children and new wife. I hope you will come soon again. Please remember me to your family.
>
> Yaichiro Okada

Dr. Erik Stensiv writes from Stockholm that Dr. Albertin Carlsson, Prof. G. De Geer, and Prof. C. Wiman are dead. He and Prof. Nils Holmgren are well. Both have the same address: Rikamuseum, Stockholm 50, Sweden.

Obituary

Frank Blair Hanson
1886-1945

In his twofold career as a teacher and investigator in zoology and as an officer of the Rockefeller Foundation, Dr. Hanson contributed importantly in the development of modern biology and natural science. To all who had the privilege of knowing him intimately, his passing on 21 July last has been the source of deep regret. He will be remembered as a highly respected teacher, an effective and productive investigator, an able administrator, and a most congenial companion.

Dr. Hanson's forebears traveled to Ohio in a covered wagon, and his family settled in Bloomington, Illinois, where he was born on 15 July 1886. As a youth he aspired to a professional career, but financial exigencies required that he make his own way after graduation from high school. While working at a government post in Washington he attended evening school at George Washington University, from which institution he received a scholarship in 1909 and a bachelor's degree in 1913. A course in zoology, taken as a formal requirement, awakened his interest and determined the course of his future career. After graduate work at the University of Illinois he was appointed instructor in zoology at Washington University, St. Louis, in 1916. The department, then housed in the basement of the Chemistry Department, was later shifted to a wooden building left over after World War I. With the late Caswell Grave, who came as head of the department in 1919, Dr. Hanson helped to plan the excellent new quarters of the department in Rebstock Hall and to develop, from inauspicious beginnings, a highly effective Zoology Department.

Appointed professor of zoology in 1924, he became one of the university's prominent figures. His lectures, given largely without notes, were unusually lucid. His genial and mellow sense of humor, frequently embellished with a delightful whimsey of expression, was completely his own. His enthusiasm for research, unaccompanied by emotional display, kindled a like spirit in his students, many of whom now occupy important posts in biology and medicine.

Author of some fifty publications, his interest first centered in comparative anatomy and embryology. In 1923 he became interested in genetics. Following a period with Professor Muller in 1927, his investigations were concerned almost exclusively with radiation genetics, a field in which he made important contributions. Particularly significant was his demonstration that radiation-induced gene mutations occur in proportion to the induced ionization, one mutation resulting from one quantum exchange.

Dr. Hanson's association with the Rockefeller Foundation began when he served as assistant in the European fellowship program of the Foundation from 1930 to 1932. A year after he returned to Washington University he joined the permanent staff of the Foundation and in 1936 he became associate director of the natural sciences division. His wide interest in scientific matters, quiet temperament, and unquestionable integrity made him well suited for this position. He was a sympathetic but undemonstrative listener and his judgments on matters of research grants were fair and impartial.

The Marine Biological Laboratory at Woods Hole was close to Dr. Hanson's heart. He overlooked no opportunity to further the work of that important center of biological research. In many ways the outstanding library of the Marine Biological Laboratory may be considered a lasting monument in his memory. With his family, Dr. Hanson delighted to spend the summers at Woods Hole.

Never robust in health, Dr. Hanson's ability to carry on in spite of a heart condition, probably contracted in his youth, is a tribute to his courage and determination. In each phase of his career he was aided by the care and assistance of his devoted wife, the former Harriet Roman Cavender, whom he married in 1910 while still an undergraduate in Washington.

Dr. Hanson's last weeks were saddened by notification that his son, Lt. Frank Blair Hanson, Jr., had been lost with his ship, a destroyer escort sunk in the Atlantic by a German submarine a few days before V-E Day. This loss was naturally a great blow and seemed to contribute to his ill health.

Besides his wife, Dr. Hanson is survived by two daughters, Miss Blair Hanson, assistant professor of French at Allegheny College, and Dr. Phyllis Claire Hanson, assistant in pathology at the University of Rochester.

Francis O. Schmitt
Massachusetts Institute of Technology

In the Laboratory

Notes on the Possibility of a Histochemical Method for Localizing Adenosinetriphosphatase

Florence Moog and H. Burr Steinbach
Washington University, St. Louis

In *Science* (1945, **102**, 429–430), Drs. Glick and Fischer presented a paper on "The histochemical localization of adenosinetriphosphatase in plant and animal tissues." Although an efficacious method for demonstrating this important enzyme histochemically will be of immense value in physiological research, our interest in this matter prompts us to point out that the invention of such a method is beset with difficulties which Glick and Fischer failed to mention.

First, it is by no means clear that the "ATPase" which the authors claim to demonstrate in their sections is in reality anything but ordinary phosphomonoesterase. That alkaline phosphomonoesterase working at about pH 9.0 will hydrolyze all three phosphate groups of ATP is well known (*3, 6*). Since this phosphomonoesterase can, of course, be demonstrated in acetone-fixed, paraffin-embedded sections (*2*) and must certainly be active in frozen sections, it is inevitable that this enzyme will register its presence by Glick and Fischer's method. Mouse heart, the test object reported on, possesses small but not inconsiderable alkaline phosphomonoesterase activity (*4*); one can say with assurance that the activity is great enough to produce a visible result in the 18- to 24-hour incubation period which Glick and Fischer found necessary for embedded sections. Consequently, the presence of ATPase[1] in either embedded or frozen material can be diagnosed only by precise comparison of tissue exposed to the ATP substrate solution with tissue treated identically except for exposure to glycerophosphate or other monoester of phosphoric acid as substrate.

Second, the notorious lability of ATPase makes it difficult to believe that this enzyme would survive the rigors of histological preparation. Every author who has reported on ATPase has remarked the necessity of working rapidly and at low temperature (see, for example, DuBois and Potter (*1*)), and in embryo homogenates the enzyme even begins to be inactivated within 10 minutes reaction at 37° (*5*). Singher and Meister (*7*) have similarly shown that purified myosin preparations tend to lose activity at 37°. Further, acetone fixation itself gradually destroys ATPase, as we have found in this laboratory by comparing the activity of a frog mesonephros kept in acetone at 5° C. for only 75 minutes with that of one held in a moist chamber during the same period: the former showed only 34 per cent of the activity of the latter. If acetone fixation is carried on longer, or at a higher temperature, and the tissue is then exposed to the heat of an embedding oven, it seems safe to assume that the ATPase activity will be entirely destroyed.

We feel, therefore, that any phosphate-liberating enzyme which may be localized in acetone-fixed tissue, whether frozen or embedded, and which requires long periods of incubation for its demonstration, cannot be accepted as ATPase unless proved to be such by the application of further tests. It may be possible to visualize the enzyme in fresh or fixed sections of highly active tissue, but the identification can be made in such cases only (a) by showing that the ATP substrate solution allows the appearance of a deposit in regions demonstrated to have little or no phosphomonoesterase activity, or (b) by showing that the ATP substrate allows deposition of calcium phosphate in a given region at a faster rate than does glycerophosphate.

References

1. DuBois, K., and Potter, V. R. *J. biol. Chem.*, 1943, **150**, 185.
2. Gomori, G. *J. cell. comp. Physiol.*, 1941, **17**, 71.
3. Lieberknecht, W. L. *Biochem. Z.*, 1939, **303**, 96.
4. MacFarlane, M., Patterson, K., and Robison, R. *Biochem. J.*, 1934, **28**, 720.
5. Moog, F., and Steinbach, H. B. *J. cell. comp. Physiol.*, 1945, **25**, 133.
6. Schmidt, G., and Thannhauser, S. J. *J. biol. Chem.*, 1943, **149**, 369.
7. Singher, H. O., and Meister, A. *J. biol. Chem.*, 1945, **159**, 491.

A Transparent Plastic Tank and Cover for the Warburg Manometric Apparatus

W. Robbie, P. J. Leinfelder, and Lee Allen
College of Medicine, State University of Iowa

It is frequently desirable to observe the tissues or organisms that are being shaken in Warburg manometric flasks. Since the water bath and cover shown in the accompanying figures is made entirely of the transparent plastic, "Plexiglas," the contents of the flasks may be observed easily at all times. The material is much lighter in weight than glass, it is less easily broken, and since the corner joints are cemented

---

[1] Since the enzyme cannot be readily identified in any case as the one which attacks only the terminal phosphate group of ATP, "adenylpyrophosphatase" would be a preferable term (see O. Meyerhof. *J. biol. Chem.*, 1945, **157**, 105).

to form a continuous piece of material, there is less possibility of leaks developing than in a glass-metal water bath. The plastic is sufficiently nonconducting to make other insulation unnecessary. The cover helps to maintain the temperature equilibrium and also aids in keeping the water in the bath clean.

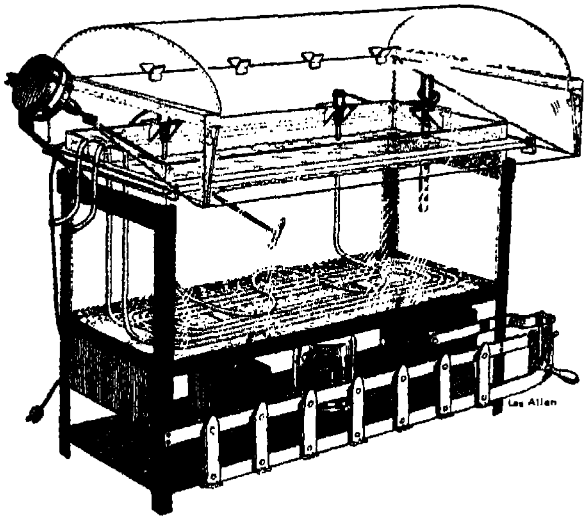


FIG. 1. Assembled transparent plastic tank and cover for Warburg manometric apparatus.

The tank now in use measures 9 × 11½ × 26 in. and is made of ⅜-in. plastic sheets, with the corners both cemented and pegged with ⅛-in. plastic dowels, as shown in Fig. 2, *e* and *f*. Very small holes were drilled the length of the dowels to allow escape of air and excess cement while they were inserted. The cover is constructed of ⅛-in. material. A cement made by dissolving plastic scraps in chloroform was used for all seals where great strength was necessary. Other surfaces were joined by flowing chloroform from a pipette between the adjacent surfaces. The shelf around the top of the tank serves both as a brace and as a platform for the sidewalls of the cover. To accommodate the sidewalls a groove is cut around the back and two end pieces of this shelf (Fig. 2, *d, e,* and *f*). The upper, curved portion of the cover rests on the sidewalls, which have "Y"-shaped receptacle hinges (Fig. 2, *b*) along the top of the back edge. The ⅛-in.-thick curved portion of the cover was bent by clamping the long edges between wooden 1 × 2's and playing a lazy gas flame under the sheet until it sagged nearly into shape. Final shaping was done by force, and the 1 × 2's were clamped in proper position with the curved sheet suspended between two tables of equal height. The "Y" hinges, and the hooked portion of the movable accessory brackets (Fig. 2, *g*) were softened by slowly heating the plastic over a Bunsen burner. When it could be bent with slight pressure, it was shaped over a form and held until cool.

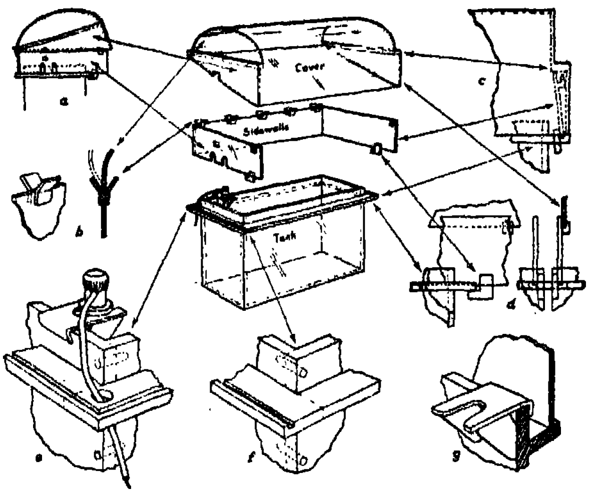


FIG. 2. "Exploded" view of "Plexiglas" tank, cover, and cover sidewalls with accompanying detail sketches: *a*, end view of assembled unit with cover lifted and resting on sidewall brackets; *b*, "Y"-shaped receptacle hinges; *c*, front view of closed cover showing how offset in cover rests on slightly displaced sidewall; *d*, solid hooks on sidewalls locking under shelf and locking device for supporting end of cover when lifted; *e*, construction of top rear corner with electrical accessory in its movable plastic bracket; *f*, construction of top front corner; *g*, view of accessory bracket on a cross-section of the top edge of tank.

In order to avoid strains and bubbles in the cemented joints of the tank it is advisable to allow 3 to 5 weeks for thorough drying.

A Simple Automatic Pressure-regulating Device for Use With Vacuum Lines

WALTER S. CLARK
Duke University

A reliable pressure-regulating valve for use with vacuum lines can easily be constructed from an ordinary drying tube and some glass tubing. The valve is designed to even off small variations in a vacuum line, rendering the partial vacuum very nearly constant. It is based on a regulator described by Asprey (*1*).

The valve (Figs. 1 and 2) consists essentially of a drying tube (b) with a side arm (a) blown into the body immediately below the bulb, a glass rod (r), and a sealed glass float (f) which is buoyed up by the mercury in the reservoir (m). The end of a glass rod which fits loosely in the tip (t) is heated in a Bunsen flame until a small, solid bead is formed with a diameter somewhat greater than that of the tip. Removed from the flame, the bead is carefully flattened and again revolved in the flame until it assumes an ellipsoidal form as shown (g). After grinding off the tip of the drying tube evenly, the rod (r) is inserted and the bead seated in the tip by grinding with emery powder. This operation is accomplished by covering the bead with oiled emery and rotating the rod with the fingers from the opposite end. For best performance, the valve seat (s) should be given a second polishing with fine emery. The rod (r) is then cut off about the level of the side arm. A float (f) can be fashioned from an ordinary glass vial which is of such dimensions as to slip freely inside the body of the drying tube (b). To operate at low-pressure differential, the valve is set into a mercury reservoir (m) and connected by means of a "T" tube into the vacuum line.

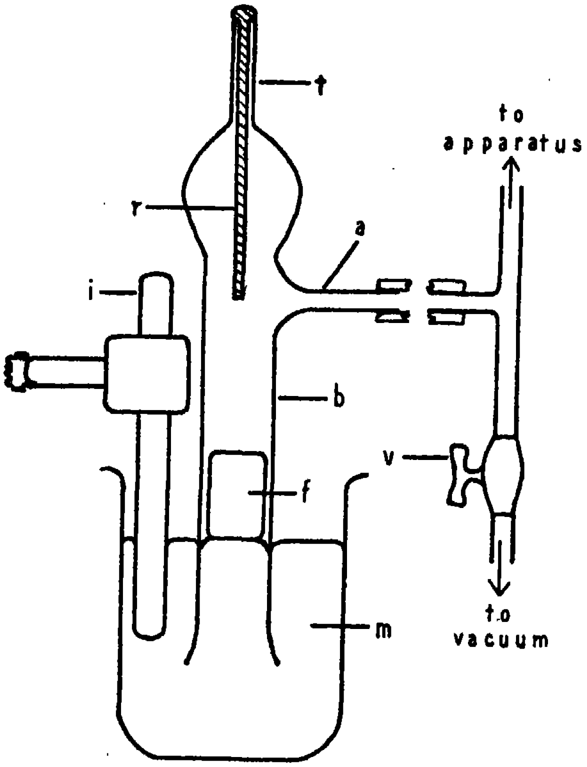


FIG. 1. Schematic view of the apparatus.

In operation, the pressure differential between the inside of the valve and the atmosphere causes the mercury to rise in the absorption tube. The float rises on the mercury column until it contacts the lower end of the valve stem (r) and causes the valve to open, permitting an influx of air. The float immediately ceases to rise, because the air entering the valve tends to lower the pressure differential and causes the mercury to fall. A balance is set up between the line vacuum and the rate of entry of air around the valve seat (s), maintaining a practically constant pressure difference. In this way minor fluctuations in the vacuum source are compensated for by a corresponding change in the rate of air intake through the valve.

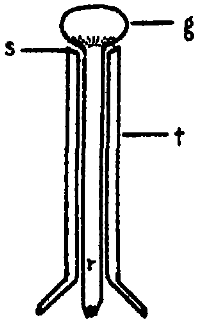


FIG. 2. Detail of the valve.

The valve operates best when connected into the vacuum line between two resistances. If, for example, the valve is used for controlling the rate of air flow through a flowmeter, operation is most efficient when connected into the vacuum line between the vacuum source and the flowmeter. The adjustable valve (v) for controlling the amount of vacuum acts as one resistance while the flowmeter acts as the second. In operation, the control valve (v) is adjusted so that the vacuum applied to the flowmeter is slightly greater than is to be used. The automatic valve then prevents any decrease in pressure below a fixed limit. When connected with a high-resistance apparatus where a strong vacuum is required, the length of the mercury column may be increased by inserting a piece of tubing through a stopper at the bottom of the drying tube and setting this into the reservoir. Any desired rate of flow can be maintained by adjusting the height of the valve above the mercury reservoir, and, where fine adjustment is required, a piece of solid glass rod (i) may be raised or lowered in the reservoir to produce slight changes in the level of the mercury. When used in connection with liquid flowmeters, no significant fluctuations were observed even after several hours of continuous operation.

Reference

1. ASPREY, G. F. *Ann. Bot.*, 1937, 1, 566–568.

Scanning Science—

Contracts have been awarded for the construction of the Schemmerhorn Hall of Natural Sciences and the Hall of Physics for Columbia College. The proposed new building is to be erected at the Boulevard and 119th street.

—24 January 1896

Letters to the Editor

Blood Group Factors and Racial Relationships

In Fig. 18 of Ashley Montagu's new book *(An introduction to physical anthropology)* is reproduced a modified version of a diagram from the first edition of Prof. A. E. Hooton's *Up from the ape,* in which are represented the relationships among the four principal groups of human populations. In this chart the Australoid group, which includes, among others, the Australian aborigenes and Ainu, is represented as intermediate between the Caucasoid and Negroid groups of peoples, while the Papuans are placed in the Negroid group. In recent studies on the distributions of the various blood-group factors it has been found that Australian aborigenes and Papuans, in common with Chinese, Japanese, Filipinos, Indonesians, and Amerindians, are characterized by the virtual absence of Subgroup A_2 and the Rh-negative type. Among Caucasoid individuals, on the other hand, as many as one-fourth of all Group A individuals belong to Subgroup A_2 and about 15 per cent are Rh negative. Negroes have an even larger proportion of A_2 individuals, and while the incidence of the Rh-negative type is only 7 to 10 per cent, there is an extraordinarily high proportion (about 40 per cent) of individuals of type Rh_0. In view of these findings, the Australian aborigenes and Papuans appear to be more closely related to the Mongoloid group than either the Caucasoid or Negroid groups, and the diagram should therefore be revised accordingly.

A. S. Wiener, M. D.

Serology Laboratory, Office of the
Chief Medical Examiner, New York City

Published Misconceptions Regarding the New Clinically Adequate Curare

In the course of amassing and editing references for a multilingual, scientific and historical bibliography of the drug curare, an incredible number of misconceptions and factual errors regarding the substance have been found. Since the literature in English commences in the late Sixteenth Century (and early Spanish references some decades earlier), certain sciolistic errors and conclusions are to be expected in the archaic literature. With the beginnings of pharmacologic (biotrepic) and clinical interest in the drug, in the early middle decades of the last century, the misconceptions become less numerous in the literature dealing specifically with its physiologic actions. However, despite the pioneering work in the ethnobotany of curare, errors still remain fairly constant in matters pertaining to the origin and nature of the drug itself. Then, with the advent in the beginning of this century of the comprehension of the alkaloidal constituents of the drug—and the fractional determinations carried on in various countries—there is a radical diminution of misconceptions relating to its chemical nature.

There still remain, however, not only an unduly large amount of the earlier errors just mentioned, but also an incredible number of widely published misconceptions regarding the *origin* of those allied substances now known generically as curare. That is to say, both the ethnobotany and the pharmacognosy of the drug are in a state of unnecessary confusion as they are currently published in the majority of pharmacologies, toxicologies, and related manuals. This chaos is further augmented to an unfortunate degree by the increasing number of commercial technical bulletins, announcements to the professions, and, indeed, even popular articles relating to recent discoveries in this field.

These published errors are now of particular moment, due to the fact that, in 1939, a form of the drug was introduced to pharmacology (biotrepy) and medicine and was almost immediately proved to be clinically functional and acceptable. While the drug has been employed somewhat in certain spastic entities, and to a large extent as an adjunct to convulsive shock therapy, its major use during the past three years has been as an anesthetic adjuvant in both civil and military surgery. In the light of its increasingly widespread use, and in order to refute, as far as possible, errors of fact regarding the ethnobotany and pharmacognosy particularly of the current, clinically adequate (and Federally accepted) form of the drug, a detailed account of the occurrence in the literature of various of these misconceptions seems necessary. This is especially so in view of the fact that certain of these misconceptions (scientific and historical) recently have been carried over into some few current medical articles and announcements.

This report, in press, is scheduled to appear in the January–February, 1946, issue of *Anesthesiology.*

Richard C. Gill

Palo Alto, California

Mumpsimus!

Despite the fact that Professor H. D. Smyth's splendid Official Report (Princeton University Press, 1945) is entitled "Atomic energy for military purposes," it is *nuclear* energy which is responsible for the effects of the so-called "atomic bomb." In 1919 P. V. Wells *(J. Wash. Acad. Sci.,* 9, 262) defined atomic forces as "those which maintain two or more atoms in equilibrium as a single system." The tremendous difference between atomic forces, as evidenced, for example, by the oxyhydrogen flame, and nuclear forces, as evidenced by the so-called "atomic bomb" (which is estimated to release only about one-half of one per cent of the total mass-energy involved), may be seen from the following:

$$4 \text{ grams H} + 32 \text{ grams O} = 36 \text{ grams H}_2\text{O} + 136{,}000 \text{ calories}$$

$$1 \text{ gram H} + 7 \text{ grams } {}_3\text{Li}^7 = 8 \text{ grams } {}_2\text{He}^4 + 5{,}000{,}000{,}000 \text{ calories}$$

Nuclear energy is of a totally different order of magnitude than atomic or chemical energy, which heretofore was the basis of explosives.

The unfamiliarity of the general public with the nuclear structure of the atom should not prevent scientists from selecting a proper expression for what is now erroneously called the ''atomic bomb.'' While this choice should be left to those who did the outstanding work, whatever expression is chosen should point up the fact that the energy released is *nuclear.* Possibly ''nuclear fission bomb'' might serve. A paper in Vol. VI of *Colloid chemistry, theoretical and applied,* now in press, is entitled ''Potential nuclear energy and some consequences of its release.'' The pioneer work on diffusion by Thomas Graham, father of colloid chemistry, was useful in working out the uranium fluoride diffusion process at Oak Ridge, Tennessee, where U 235 was separated from U 238. In fact, it was in his paper on ''Liquid diffusion applied to analysis'' (*Philos. Trans. roy, Soc.*, 1861) that Graham proposed the word ''colloid'' to describe those substances which, as regards to diffusion, ''are slow in the extreme.''

Please consider this as a protest against the perpetuation of a *mumpsimus*, a term introduced into our language to indicate persistence in obvious error, from the fact that an old priest who had for forty or more years used this word refused to change to *sumpsimus*, even when shown the correct word in the prayerbook.

JEROME ALEXANDER

50 East 41st Street
New York 17, New York

Proposed International Association of Scientists

Would it not be appropriate for the American Association for the Advancement of Science to join with the venerable British Association for the Avancement of Science in organizing a United Nations Association for the Advancement of Science? Such an international association of scientists might serve, through the example of the American and British Associations, to promote the best interest of scientists generally, throughout the world, toward international harmony and good will.

The American Association of Scientific Workers proposes that there be full cooperation with the United Nations Educational, Scientific, and Cultural Organization (UNESCO), which was created at the Charter Conference held at London in November 1945. Representatives of forty-three nations unanimously approved the charter for UNESCO. The science division of UNESCO offers an opportunity for effective international cooperation in science.

Perhaps the AAAS could suggest that scientific societies throughout the world apply for membership in UNESCO. This would form the basis for a United Nations Association for the Advancement of Science.

Such an organization could serve many important functions. Most importantly, it could help to maintain the standards and ideals of scientists throughout the world. It might effectively promote international congresses in various scientific fields. Helpfully to all scientists, it might publish a weekly international scientific journal. Indeed, *Science* and *Nature* might join together to become such an international scientific journal, of course with an opportunity for publication and translation of articles in various languages. Such an organization might effectively promote interchange of scientific workers and scientific information throughout the world.

It appears that an admirable opportunity exists for scientists to indicate their interest in international scientific cooperation. Much may depend on the reaction which scientists may give to this opportunity.

CHAUNCEY D. LEAKE, *Vice-President*
Medical Branch, University of Texas, Galveston

The Portuguese Man-of-war as a Food Source for the Sand Crab (*Emerita pacifica*)

Along the windward side of the Island of Oahu, Territory of Hawaii, there are numerous sandy beaches which are widely frequented for bathing purposes. Although extremely popular and well adapted for recreational purposes, there are at various times large numbers of the Portuguese man-of-war, *Physalia utriculus* Escholtz, present in the water. These animals drift in from the open sea, and their poisonous sting is highly obnoxious to bathers.

In an attempt to determine the number of individuals present at Lanikai Beach, the number of individuals which had been washed up along a measured distance of the beach were counted. It was noted that there were many fewer along the beach than were present in the water and that such a method would not produce an accurate quantitative measure. Although it was not possible to make any further observations on the number of Portuguese men-of-war present, the reason for the discrepancy in numbers was soon discovered.

Along the beach at the intertidal zone, and concentrated particularly in the area of wave wash, are to be found large numbers of the Pacific sand crab, *Emerita pacifica* (Dana). These animals were observed to grasp the Portuguese man-of-war as it was being washed in and draw it quickly beneath the sand. In many instances the crab was observed to have difficulty in drawing the float under, and the next wave would carry both crab and coelenterate higher onto the beach. As a Portuguese man-of-war became stranded, numerous sand crabs were observed scurrying toward it from distances up to five feet during the interval between waves. The stimulus for this behavior is evidently visual, since it was observed to be preceded by the extension of the stalked eyes above the surface of the sand and outflowing water, and the conditions would seem to exclude the use of the other senses. It is possible to collect large numbers of the sand crab by digging out the sand beneath such stranded Physalia. In two instances, 23 and 11 individuals of both sexes and of different sizes were obtained by scooping out a double handful of sand under Physalia with floats which measured 2.5 and 2.0 inches in length, respectively. Local beach fishermen collect the sand crab for bait by digging beneath stranded men-of-war in this manner.

There can be no doubt that the sand crabs utilize the Physalia for food, inasmuch as the blue color of the tissues of Physalia could be readily observed in the mouth, stomach, and gut of crabs taken in the manner described above. Furthermore, microscopic examination of the digestive-tract contents demonstrated the presence of nematocysts. The poison appears to have no deterrent effect on the crab. The sand crab was not observed to feed on any other material which was washed ashore, although pieces of fish and meat were used in an attempt to attract them. It seems unlikely that these animals feed exclusively upon Physalia, but it is certain that this coelenterate constitutes an important item in their diet.

DAVID D. BONNET

Honolulu, T. H.

High School Science

The anomalous situation of a declining registration in science courses in the high schools in an age which has been called either the "Scientific Age" or the "Atomic Age" is a concern of all who are interested in the advancement of science.

Before the outbreak of the war there had been a constant decline in the election of science courses. The war training program resulted in an artificial boom. Boys, particularly, were either programmed arbitrarily in science courses as a preparation for induction in the Army, or they were persuaded to take such courses by the lure of more favorable assignments in the Army. Now there are indications that the decline has been resumed. How may we account for this apparent lack of interest in science election in an age when science and its applications are having such tremendous influences in shaping our lives?

It may appear trite to repeat that the primary function of secondary schools is to give the pupils the most desirable educational experiences at the adolescent level. Secondarily, they should be concerned with "preparation for life beyond the high school." We have had a very extensive experiment under the auspices of the Progressive Education Society in its Eight-year Study, the results of which support the validity of these objectives in the order named. Nonetheless, we still use the criteria of college entrance requirements as the chief determinants of the high school curriculum for those who plan to continue their education beyond the secondary schools.

Here I believe is the crux of the problem. College admission boards have accepted a year of science as adequate preparation for college work as against three or more years of language, two or more years of mathematics, three or more years of social studies. The college admission boards are undoubtedly influenced by their members, which include the professors of the various subject areas. May we then place the responsibility for this inadequate science requirement upon our college professors of science? I believe we may do so with some justification.

It has been my experience, as well as that of many of my colleagues, that many college professors of science are inclined to belittle science instruction on the secondary school level. It is a very common experience to require pupils who have had secondary school science to repeat such work in the colleges. We have the testimony of great numbers of our students who have had chemistry, for example, that the work they had in our high schools was in every way comparable in quality and quantity with that of the freshman course in college. The same judgment has been made with respect to biology and physics.

In committee meetings between college professors and administrators and secondary school teachers and administrators, I have heard it asserted that the science professors would just as soon have the high school graduates come to college without any science preparation. And such statements are made in the presence of professors of other subject areas. Language men hold no such superior attitude, and accept at face value the language preparation given in secondary schools.

I cannot speak with authority of the quality of the science instruction in other secondary schools in this country, but I do know what it is in this large city, and I am quite certain it is matched in most of the high schools of the country. Certainly the science instruction in any high school is as effectively done as is that in any other subject area. Why, then, should not our college professors of science accept the work done in high school science as adequate preparation for advanced study as professors in other subject areas do?

The present one-year entrance requirement may be, and often is, satisfied by a first-year science course in "general" science. The course is general and elementary, the children are immature, the teaching procedures necessarily largely demonstrative and descriptive, and the contents pretty well forgotten by graduation time. If a boy or girl is accepted for admission to a college with only such science preparation, the college science professor may not draw any conclusions from it as to the quality of secondary school science instruction.

I am writing this note to emphasize the need and importance of a continuing science program throughout the period of education of all children. College science professors may not, and should not, remain aloof. Promoting the study of science at lower levels will not only improve the quality of instruction possible at higher levels, but will promote an interest in science in the community and in the country, and develop the knowledge, attitudes, and appreciations necessary for life in this scientific age.

Specifically, if college admission boards were to require a three- or even a two-year science sequence for admission to college, it would improve the situation immeasurably with respect to the study of science in secondary schools. The three-year sequence is the more desirable, for it will enable the secondary schools to give the pupils a more rounded science experience. We should accept a two-year sequence as a step in the right direction.

CHARLES A. GRAMET, *Administrative Assistant*
Midwood High School, Brooklyn, New York

Book Reviews

The social systems of American ethnic groups. (Yankee City Series, Vol. III.) W. Lloyd Warner and Leo Srole. New Haven, Conn.: Yale Univ. Press; London: Humphrey Milford, Oxford Univ. Press, 1945. Pp. xii + 318. $4.00.

This series is a significant contribution to the social sciences as an ambitious attempt to analyze in detail the life of a modern American city with the methodological tools of the anthropologist as well as those of the sociologist. In the present volume the authors describe the processes and extent of adaptation of the various ethnic groups to the culture of the city. It is an addition both to the general description of life in Yankee City and to our knowledge of the problems of immigrant peoples adjusting to an alien culture.

The scope of the study is summarized by the authors in these terms:

> "1. To describe in detail . . . the steps and processes by which eight ethnic groups have
>
> a. progressively advanced in the major status hierarchies of Yankee City and
>
> b. progressively adapted the internal organization of their community systems.
>
> 2. To analyze the factors . . . attending these processes. . . .
>
> 3. To abstract wider generalizations concerning the nature of social assimilation and acculturation" (p. 32).

The advance of the ethnic groups in residence location, economic status, and social status, and changes in such institutions as the family, the church, language and the school, and "associations" are analyzed comparatively, institution by institution. These analyses are carefully done in terms of the precise historical circumstances effecting each change. Much detailed information is added to our knowledge of how culture change is initiated and the manner in which old institutions adjust in culture contact.

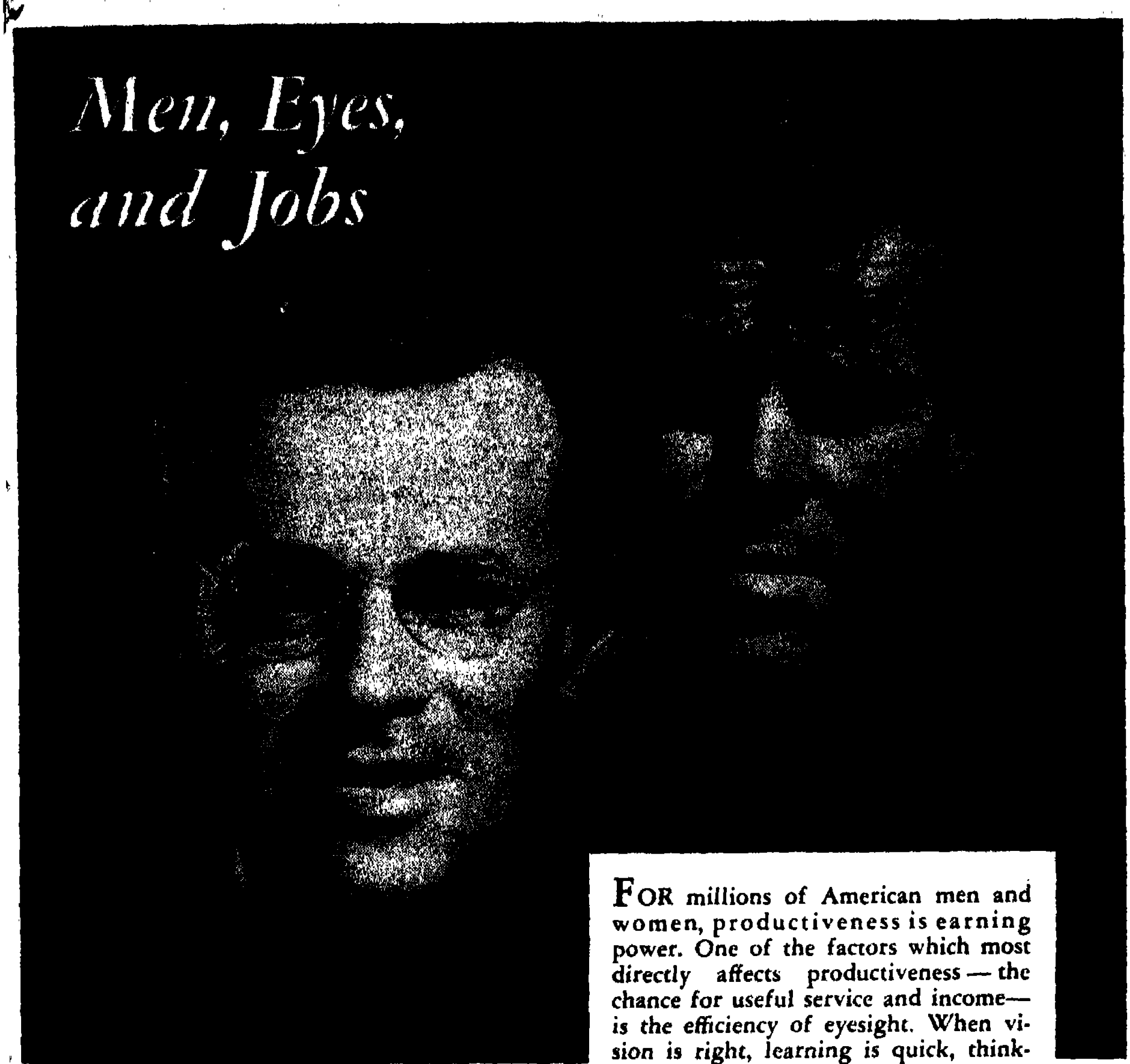
However, the general idea that ethnic groups experience "conflicts" and undergo "adjustments" has long been established and accepted. It is time to take the next step and study acculturation as a condition of forced and accelerated change of culture *patterns*, in which the relationships between institutions and their function in terms of human needs are thrown into relief, and thereby use the "laboratory situation" of acculturation to facilitate an understanding of the dynamics of culture. To do this the authors should have treated the cultures as units, for to study culture one must study it as a complete pattern of functionally related institutions. As a matter of fact, even individual institutions should not be studied apart from an explicitly stated cultural framework, since the significance of any one institution lies in its functional relationship to the entire pattern.

Also, treatment of our contact with ethnic groups as though it is merely a matter of their becoming Americanized is a tacit concession to ethnocentrism. Acculturation is not a one-sided affair. Cultures in contact influence *each other*. Furthermore, an entire field of study, the influence of the subordinate groups on the dominant group and on other subordinate groups, is automatically excluded from consideration.

The authors present their "wider generalizations concerning the nature of social assimilation and acculturation" in the form of a statement that the "degree of subordination" and the "period of assimilation" of ethnic groups in America are a function of: (1) cultural divergence from the American norm, (2) racial divergence from the American norm, or (3) a combination of (1) and (2). A table is presented, based on this generalization and using language and religion as the sole criteria of cultural similarity. This table is offered as a basis for predicting the fate of ethnic groups introduced into the American milieu.

There can be no issue with the generalization that cultural and racial similarity tend to facilitate assimilation into American society; it is what one with a knowledge of the history of American ethnic groups would have concluded a priori. However, exception may be taken to using such a simplistic scheme as a basis of prediction. Causation in the social sciences is not a simple affair of one or two variables, but is the result of a number of variables, some of which tend to be dominant in most instances. These variables are conditioned by historical circumstances which often give dominance to variables which have previously been regarded as minor factors. A number of additional variables may be suggested which have at times played important roles in determining the fate of ethnic groups: the size of the group in relation to the assimilating groups, the prestige of the country of the group's origin, the ability or inclination of the group to accommodate rapidly (which can be a matter quite apart from its cultural similarity), plus all the possible accidental historical circumstances which may surround the meeting of the two groups. Exceptions may be noted among the groups studied by the authors. Some of the groups did not "advance" during the early years of their residence in Yankee City largely because they wanted to earn money to take back to Europe and did not want to advance in the social system of Yankee City. On the other hand, the Jews advanced rapidly, despite the fact that by virtue of their language and religion they belonged at the bottom of the list of these ethnic groups. Their advancement was due to their superior familiarity with business life, a cultural factor not considered in the authors' table.

Nevertheless, the field work, analysis, and writing of this study are excellent. When confronted with a concrete problem of causation, the authors do not rely on the simplism of the final chapter, but make a detailed analysis in terms of all relevant factors. Likewise, the description of institutions stresses their function in a



FOR millions of American men and women, productiveness is earning power. One of the factors which most directly affects productiveness — the chance for useful service and income— is the efficiency of eyesight. When vision is right, learning is quick, thinking is clear, actions are sure.

The first products of B&L were spectacles. For the 93 years since its founding, this firm has taken the lead in the development of products for the scientific correction of vision—refractive and diagnostic instruments of incomparable precision, ophthalmic lenses of advance design, spectacle frames and mountings, and laboratory machinery. Bausch & Lomb Optical Company, Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

—all signs point to these
new HOEBER texts

Nauss
MEDICAL PARASITOLOGY & ZOOLOGY

→The essentials of parasitology and zoology, including laboratory technics. "Welcomed as an important, useful, much needed textbook for medical students, teachers, and technicians," says *Arch. Path.* By PROF. RALPH W. NAUSS, M.D., Cornell Univ. Med. School; *535 pp. 95 illus., $6.00*

Thienes
FUNDAMENTALS OF PHARMACOLOGY
For Students & Practitioners

→Up-to-the-second pharmacology by PROF. CLINTON THIENES of Southern Calif., widely adopted in the few months since publication. All important U.S.P.XII preparations are included. "Novel arrangement, condensed form, and readable style make it a book teachers may recommend without reservation."—*Ann. Int. Med. 535 pp. 36 illus., $5.75*

Everett
MEDICAL BIOCHEMISTRY

→Highly successful text reflecting years of teaching experience, by PROF. MARK EVERETT of Oklahoma. Writes the *J. Amer. Med. Colleges:* "Clarifies in a simple way the relation of biochemistry to medicine and its problems." This popular biochemistry text is also a convenient valuable graduate reference. *708 pp., 103 tables & charts, $5.75*

→*mail today!*
SC26

PAUL B. HOEBER, INC. *Publishers*
Medical Book Dept. of Harper & Brothers
49 E. 33rd St., New York 16, N. Y.

Please send me: ....

☐ On approval ☐ Charge ☐ Check encl.

Name: .... Address: ....

broad, cultural framework, which is apparently an implicit referent for the authors, even though it is nowhere explicitly stated.

RAYMOND A. BAUER, Ensign, USNR

Washington, D. C.

Advances in carbohydrate chemistry. (Vol. I.) W. W. Pigman and M. L. Wolfrom (Ed.). New York: Academic Press, 1945. Pp. xii + 374. $6.00.

This book is the first volume of a series, which is designed to present special topics in the chemistry of the carbohydrates as completely as the literature will permit at the time of the preparation of the manuscript. It is fortunate indeed that the word "recent" was not prefixed to this name, for such a prefix has no significance within a few weeks or months of the time the book appears on the market.

According to the Preface, "The increasing tempo of research and the consequent increased specialization of research workers make it desirable to provide frequent reviews of important developments in carbohydrate chemistry, not only for the carbohydrate chemist, but also for research workers in other fields and industrial chemists and teachers."

The current volume devotes 36 pages to the Fischer cyanohydrin synthesis and the configurations of higher-carbon sugars and alcohols (C. S. Hudson); 40 pages to the altrose group of substances (Nelson K. Richtmyer); 52 pages to carbohydrate orthoesters (Eugene Pacsu); 18 pages to thio- and seleno-sugars (Albert L. Raymond); 28 pages to the carbohydrate components of the cardiac glycosides (Robert C. Elderfield); 18 pages to metabolism of the sugar alcohols and their derivatives (C. Jelleff Carr and John C. Krantz, Jr.); 54 pages to the chemistry of the nucleic acids (R. Stuart Tipson); 32 pages to the fractionation of starch (Thomas John Schoch); 30 pages to the preparation and properties of starch esters (Roy L. Whistler); 36 pages to cellulose esters of organic acids (Charles R. Fordyce); and 30 pages to the Index.

The footnote bibliographies list 1,001 literature citations. The book is written well, edited well, and printed well. It is a must volume for any scientific library.

EDWARD F. DEGERING

Purdue University

Scientific Book Register

ADDISON, HERBERT. *A treatise on applied hydraulics.* (3rd ed.) New York: Wiley, 1945. Pp. 623. (Illustrated.) $6.50.

ANSON, M. L., and EDSALL, JOHN T. (Eds.) *Advances in protein chemistry.* (Vol. II.) New York: Academic Press, 1945. Pp. xiv + 443. $6.50.

BAILEY, ALTON EDWARD. *Industrial oil and fat products.* New York: Interscience Publishers, 1945. Pp. 745. (Illustrated.) $10.00.

FOR YOUR CONVENIENCE—*BIBLIOGRAPHY:*

Fiberglas* Materials in Medicine

Many data have been compiled by physicians and others engaged in medical research as a result of increasing interest in Fiberglas Materials and their medical aspects. Some of them may help you solve a problem. Check the numbers of the items in which you are interested, or merely mail the coupon for a copy of "Pioneering Uses of Fiberglas in Medicine".

1. "Glass Plastic Cast" by Roger Anderson, M.D., and Herbert R. Erickson, M.S., in *The American Journal of Surgery*, LXIX, 3 (September 1945), pp. 299-305.

2. "Fiberglas Used as a Root Canal Filling Material" by Harry Maeth, D.D.S., in *The Dental Digest*, LI, 10 (October, 1945), pp. 555-556.

3. "Significance of the Nitrogen Loss in the Exudate from Surface Burns" by John W. Hirshfeld, M.D., Harold H. Williams, Ph.D., William E. Abbott, M.D., Carl G. Heller, M.C., Ph.D., and Matthew A. Pilling, M.D., in *Surgery*, XV, 5 (May, 1944), pp. 766-773.

4. "Fiberglas Suture Material" by Roy Philip Scholz, M.D., and Philip S. Mountjoy, M.D., in *The American Journal of Surgery*, LVI, 3 (June, 1942), pp. 619-621.

5. "New Type Plasma Filter Will Aid in Prevention of Fatal Wound Shock" in *Surgical Business*, V, 5 (May, 1942), pp. 20-21.

6. "Rayable Gauze as a Factor of Safety in Surgical Operations" by Edward F. Lewison, M.D., in *Bulletin of the American College of Surgeons*, XXVII, 1 (January, 1942), pp. 39-40.

7. "The Effects of Fiberglas on Animal and Human Skin" by Marion B. Sulzberger, M.D., and Rudolf L. Baer, M.D., in *Industrial Medicine*, XI, 10 (October, 1942), pp. 482-484.

8. "Fiberglas Health Hazard Investigation" by Walter J. Siebert, M.D., in *Industrial Medicine.*

9. "Hazards of Exposure to Glass Wool, Glass Frit or Foam-Glass" by B. J. Hein, M.D., in *The Journal of the American Medical Association*, CXXIV, 3 (January 15, 1944), pp. 187-188.

10. *Report of the Director of The Trudeau Foundation*—1941 by LeRoy U. Gardner, M.D., last page, describing findings based on inhalation tests in which animals were exposed to glass fiber dust.

11. *Health Aspects of Fiberglas Materials*, 8-page brochure, published in April 1945, for plant physicians, industrial hygienists, safety engineers, and others interested in a documented summation of facts relating to the subject.

12. *Transcript of Remarks* on "Health Aspects of Fiberglas Materials" by W. G. Hazard, U.S.P.H.S. in *Proceedings of the Rhode Island Industrial Health Institute*, May 19, 1943.

13. "Safe Handling of Fiberglas in Shipbuilding" by Edward G. Ames in *1944 National Safety Congress Transactions.*

14. "Use of Fibrous Glass by the Army and Navy", by Major Hubert D. Keiser, A.U.S., in *Mining Technology*, VII, 3 (May, 1943), pp. 1-14. Contains a comprehensive description of manufacturing processes.

15. "Fibrous Glass Insulation: Health Aspects of", joint memorandum (December 30, 1942) of the Bureau of Ships and the Bureau of Medicine and Surgery (BUMED FS/838-1 (103)).

16. *Pioneering Uses of Fiberglas Materials in Medicine*, 16-page brochure describing ways in which Fiberglas is being used to solve medical problems.

FIBERGLAS
*T. M. Reg. U. S. Pat. Off.

Please send me the items checked below:

1, 2, 3, 4, 5, 6,
7, 8, 9, 10, 11, 12,
13, 14, 15, 16

Samples of Fiberglas, in any available form, will also be sent to qualified persons.

OWENS-CORNING FIBERGLAS CORP.
2038 Nicholas Bldg., Toledo 1, Ohio

Name..................................
Address..................................
Street..................City..............

Bancroft, Frederic W., and Murray, Clark Ray. *Surgical treatment of the motor-skeletal system.* (2 vols.) Philadelphia: Lippincott, 1945. Pp. 1254. (Illustrated.) $20.00.

Barron, Harry. *Modern plastics.* New York: Wiley, 1945. Pp. 680. $7.50.

Bell, Eric Temple. *The development of mathematics.* (2nd ed.) New York: McGraw-Hill, 1945. Pp. 650. $5.00.

Bothman, Lewis, *et al.* (Eds.) *1945 year book of eye, ear, nose and throat.* Chicago: Year Book Publishers, 1945. Pp. 544. (Illustrated.) $3.00.

Burrows, Harold. *Biological actions of sex hormones.* Cambridge: Univ. Press, 1945. Pp. x + 514. $8.50.

Campbell, John D. *Everyday psychiatry.* Philadelphia: Lippincott, 1945. Pp. 333. $6.00.

Coca, Arthur F. *Familial nonreaginic food-allergy.* (2nd ed.) Springfield, Ill.: C. C. Thomas, 1945. Pp. 191. (Illustrated.) $3.75.

Foot, Nathan Chandler. *Pathology in surgery.* Philadelphia: Lippincott, 1945. Pp. 511. (Illustrated.) $10.00.

Groff, Robert A., and Houtz, Sara Jane. *Manual of diagnosis and management of peripheral nerve injuries.* Philadelphia: Lippincott, 1945. Pp. 188. (Illustrated.) $8.00.

Hawley, Gessner G., and Leifson, Sigmund. *Atomic energy in war and peace.* New York: Reinhold, 1945. Pp. x + 211. (Illustrated.) $2.50.

Huygens, Christiann. *Treatise on light.* (Tr. by Sylvanus P. Thompson.) Chicago: Univ. Chicago Press, 1945. Pp. 140. (Illustrated.) $1.50.

Jack, Homer A. *Biological field stations of the world.* (Chronica Botanica, Vol. 9, No. 1.) Waltham, Mass., Chronica Botanica, 1945. Pp. 74. $.25.

Jamieson, E. B. *A companion to manuals of practical anatomy.* (6th ed.) New York: Oxford, 1945. Pp. 744. $4.50.

Keefer, C. S., and Anderson, D. G. *Penicillin in the treatment of infections.* New York: Oxford, 1945. Pp. 56. $2.00.

Leffingwell, Georgia, and Lesser, Milton A. *Glycerin, its industrial and commercial applications.* Brooklyn, N. Y.: Chemical Publishing Co., 1945. Pp. 268. (Illustrated.) $5.00.

Lister, Eugene C. *Electric circuits and machines: an introduction to practical electricity.* New York: McGraw-Hill, 1945. Pp. 370. (Illustrated.) $3.50.

Luros, Gretchen O., and Oram, Florence. *Essentials of chemistry.* (5th ed.) Philadelphia: Lippincott, 1945. Pp. 637. (Illustrated.) $3.25.

Mackenzie, DeWitt. *Men without guns.* Philadelphia: Blakiston, 1945. Pp. xii + 48. (Illustrated.) $5.00.

Major, Ralph H. *Classic descriptions of disease.* (3rd ed.) Springfield, Ill.: C. C. Thomas, 1945. Pp. 679. (Illustrated.) $6.50.

Marshall, F. H. A., and Halnan, E. T. *Physiology of farm animals.* (3rd ed.) New York: Macmillan, 1945. Pp. 351. (Illustrated.) $4.50.

Mawhinney, M. H. *The heating of steel.* New York: Reinhold, 1945. Pp. viii + 265. (Illustrated.) $4.75.

McAtee, Waldo Lee. *The ring-necked pheasant and its management in North America.* Washington, D. C.: American Wildlife Institute, 1945. Pp. 331. (Illustrated.) $3.50.

McKee, Edwin D., and Resser, Charles E. *Cambrian history of the Grand Canyon region.* Pt. I: Stratigraphy and ecology of the Grand Canyon Cambrian (McKee); Pt. II: Cambrian fossils of the Grand Canyon (Resser). Washington, D. C.: Carnegie Institution of Washington Publication 563, 1945. Pp. viii + 232. (Illustrated.) $2.50 (paper); $3.00 (cloth).

Merrill, Elmer D. *Plant life of the Pacific world.* New York: Macmillan, 1945. Pp. 311. (Illustrated.) $3.50.

Nichols, John Treadwell, and Bartsch, Paul. *Fishes and shells of the Pacific world.* New York: Macmillan, 1945. Pp. 217. (Illustrated.) $2.50.

Ogilvie, Robert S. *Manual of electroencephalography for technicians.* Cambridge, Mass.: Addison-Wesley Press, 1945. Pp. xii + 100. (Illustrated.)

Richens, R. H. *Forest tree breeding and genetics.* (Imperial Agricultural Bureaux Joint Publication No. 8.) Cambridge, Eng.: Imperial Bureau of Plant Breeding and Genetics, 1945. Pp. viii + 79. 5s.

Rostand, Jean. *Esquisse d'une histoire de la biologie.* Paris: Librairie Galimard, 1945. Pp. 260. (Illustrated.) 140 fr.

Sears, Francis Weston. *Principles of physics, III: Optics.* Cambridge, Mass.: Addison-Wesley Press, 1945. Pp. viii + 331. (Illustrated.)

Seelye, Elwyn, E. *Design: data book for civil engineers.* New York: Wiley, 1945. (Illustrated.) $7.50.

Skrotzki, Bernhardt G. A., and Vopat, William A. *Applied energy conversion; a text in power plant engineering.* New York: McGraw-Hill, 1945. Pp. 522. (Illustrated.) $5.00.

Thomas, Atha, and Haddan, Chester. *Amputation prosthesis.* Philadelphia: Lippincott, 1945. Pp. 305. (Illustrated.) $8.00.

Weygand, Conrad. *Organic preparations.* New York: Interscience Publishers, 1945. Pp. xiii + 534. (Illustrated.) $6.00.

——. *Blueprint for world civil aviation; the Chicago International Civil Aviation Conference of 1944.* (U. S. Dept. of State, Conf. Ser. 70.) Washington, D. C.: Government Printing Office, 1945. Pp. 39. $.15.

• 2 APR 1946

SCIENCE

Vol. 103, No. 2667 Friday, February 8, 1946

Uniform Luminescent Materials[1]

C. G. A. Hill, A.R.C., B.Sc.

Material Research Laboratory, Philips Lamps, Ltd., London, England

THE PHENOMENAL INCREASE in the production of luminescent materials in Britain since the advent of fluorescent lighting has raised manufacturing problems of a type not usually associated with inorganic preparations. These problems are due to the difficulties which arise when attempts are made to produce large quantities of material having uniform luminescent characteristics.

There are several properties of luminescent material, or phosphore, which may be considered its luminescent characteristics. The physical properties of all crystalline solids can be divided into two classes: those which are the same for any two specimens of the same material, and those which are influenced by the past history of the particular sample. The "structure sensitive" properties which form the second class are often very sensitive to the presence of small amounts of impurity. Luminescent characteristics of inorganic solids which fall into this class are as follows:

(1) *Excitation spectrum.* Most materials are excited by a broad band of wave lengths in the ultraviolet, having one main, and possibly subsidiary maxima. The position of the band usually coincides with the long-wave length edge of the fundamental crystal absorption, but the details will depend on the method of preparation (Fig. 1).

(2) *Emission spectrum.* The energy distribution of the emitted light is often the most important characteristic of the material, because it determines the color. In certain cases this is very difficult to control. In commercial phosphores it consists of one or more bands from 500 to 3,000 angstroms wide, and it may extend considerably into the ultraviolet.

(3) *Efficiency.* No absolute value can be given to the efficiency of any luminescent material which will be significant in all its applications, because of the complexity of the phenomena involved. For practical purposes, therefore, it is customary to compare the relative efficiencies of different materials under conditions of excitation similar to those met with in use. In excitation by ultraviolet light the quantum efficiency is a significant figure; but this must be coupled with the wave lengths of excitation, and emission of the energy conversion is required (since the energy of one quantum E, of wave length λ, is hc/λ), and finally, the sensitivity of the eye to light of different wave lengths must be considered if the light output is to be estimated from any absolute physical measurements.

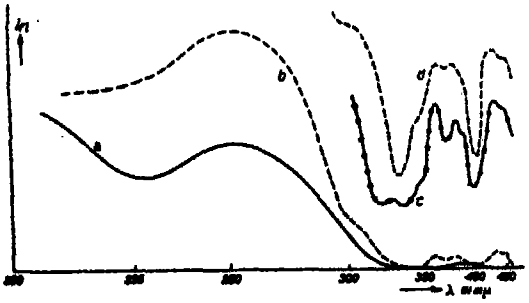


FIG. 1. Excitation spectra of zinc silicate phosphores at room temperature: *a.* Zn_2SiO_4—Mn $1\,^0/_{00}$; *b.* Zn_2SiO_4—Mn 5%; *c.* Zn_2SiO_4—Mn 2% (band system enlarged); *d.* Zn_2SiO_4—Mn 5% (band system enlarged).
(*After* Kroger, *F. A. Physica*, 1939, 6, 764.)

In cathode-ray tubes the efficiency of the luminescent material is often a function of the electrical characteristics of the tube, the thickness of the layer of material and the nature of its support, while in the case of X-ray screens the efficiency is largely determined by the absorptive power of the material and so will vary with the wave length of the radiation used.

(4) *Phosphorescence.* Of the total energy which is absorbed during the excitation of a phosphore, a part is emitted immediately (fluorescence), a part is degraded into heat, and a third part may be stored for a period within the crystal, to be liberated later by either of the above processes. The phosphorescent characteristics of the material are determined by the total amount of energy which is stored within it and the rate at which part of this energy is re-emitted as light. It is difficult to specify these characteristics absolutely, and for practical purposes relative measurements are used. The requirements of various applications differ widely. Some may require

---

[1] Acknowledgments are due to Mr. J. A. M. vanMoll and the Directors of Philips Lamps, Ltd., for permission to publish this paper.

complete extinction within a few milliseconds, while others may need a continuous glow lasting several hours.

In addition to these specifically luminescent characteristics there are all the usual physical and chemical properties of any pigment, such as particle size and stability. The control of each brings its own problems.

THEORETICAL FRAMEWORK

Only a very brief outline can be given here of the theoretical framework by which these properties are related to each other and to the composition and method of preparation of the phosphores. Several reviews have been published in recent years which deal with the matter in greater detail (*1*).

The electrons of an atom in a gas, as is well known, occupy certain discrete energy states and can be excited, by various means, into other states of higher energy provided that these are not already occupied. Such transitions are accompanied by the absorption or emission of practically monochromatic radiation. When a large number of atoms are brought together to form a crystal, the energy levels of the outer valence electrons are profoundly modified, owing to the development of the binding forces which hold the crystal together.

The sharp levels of the individual atoms broaden out into bands (Fig. 2). Each broad band of allowed energies is made up of discrete states, but these are so dense, being equal to the number of ions in the crystal, that they can be considered as continual. It is no longer possible to say that any particular electron is associated with any one particular ion; they are all shared by the whole lattice. The electron population of any band is limited by the fact that each of its component levels can be occupied by only two electrons having opposite spins. In all ionic crystals there is a filled band in which every allowed level is fully occupied, separated by a gap of several electron volts from the next band above it, which is normally empty.

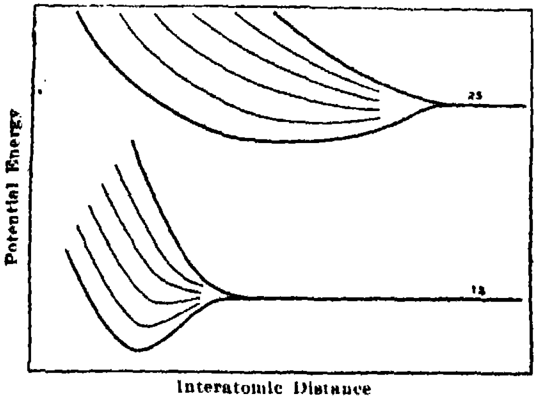


FIG. 2. (*After* Shockley, *West. Bell System Tech. J.*, 1939, 18, 645.)

Electrons may be excited into this upper band by the absorption of a quantum of radiation of sufficiently short wave length, and once there, in a perfect crystal, they would be free to move under the lattice under the influence of an applied electric field. An excited electron will eventually return to the lower band, either by a direct transition with the emission of a quantum of radiation, or by a more complex mechanism, connected with the thermal vibrations of the lattice by which the energy is lost as heat. For most pure substances, at ordinary temperatures, the latter is the case.

If, however, the energy gap between the two bands is bridged here and there by other allowed energies, light emission is more likely to take place. This is just what may happen when a small amount of an impurity ion is introduced into the crystal lattice. The discrete levels of the impurity ion, which remain localized in its neighborhood, may fall within the forbidden energy gap. The excited electrons may then fall from the upper band to one of these levels, emitting a band of wave lengths, the position of which will depend on the size of the energy gap between the bottom of the band and the impurity level.

When the impurity ion possesses a large number of closely spaced levels in this region, there is even less chance of a visible emission than for the pure substance, as transitions between these levels will result only in the emission of very small quanta in the infrared. These two possibilities correspond to the action of "activators," without which many materials will not luminesce strongly at room temperatures, and "poisons," the presence of which kills luminescence which would otherwise be evident.

Theory at present gives little indication of the concentrations at which activators should be used, but empirical data show that optimum concentrations vary for different methods of excitation of the same material, apart from wide variations between different materials (Fig. 3).

The introduction of the activator produces strains in the lattice, and these result in local disturbances of the energy bands. Similar effects are also produced by a number of other types of lattice defect which are present in all normal crystals. They are usually due to the displacement of lattice ions from their normal positions. Electrons excited into the empty band may become trapped in the neighborhood of these defects, to be liberated later by thermal vibrations. These electrons account for the very long phosphorescence of certain materials. The number and type of defect can be controlled to some extent by the heat treatment given to the material.

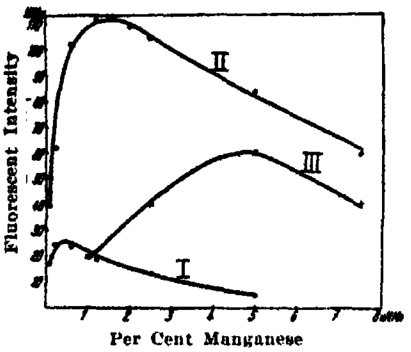


FIG. 8. Effect of manganese concentration on the fluorescent intensity of zinc silicate excited by (I) 740 A.U., (II) 2,537 A.U., and (III) 3,650 A.U.
(*After* Ruttenauer, *A.Z. Tech. Phys.*, 1938, 19, 148.)

PRACTICAL ASPECTS

The mechanism of luminescence gives some explanation of the necessity for extremely careful control of every stage in the manufacture of a phosphore. There is, however, a considerable variation in the tolerances which can be allowed as between one phosphore and another. In one case the emission spectrum may be invariable and the efficiency sensitive only to the heat treatment and the purity, while in another case the emission spectrum may be sensitive to very slight changes in the composition and the firing schedule.

For certain purposes the particle size must be controlled within narrow limits at about a two-inch diameter. Normal methods of comminution can seldom be used freely, because of the destructive effect of grinding on the luminescence, so that efforts have been made to produce the material with the correct particle size in the first place.

Below are details of the preparation of three luminescent materials which are suitable examples of the three most important chemical classes: the silicates, the tungstates, and the sulphides. For this purpose it is assumed that the two first are to be used in a normal fluorescent lamp and that the sulphide is to be a component of a white television screen.

Zinc beryllium silicate. This material, which is activated by manganese, can be prepared so as to fluoresce with any color between a very greenish yellow and a deep orange. The first step in its preparation is the purification of its constituent oxides. Various methods can be used to purify the zinc, beryllium, and manganese, most of which rely on well-known reactions of analytical chemistry. The purification is sufficient in this case when the copper, iron, and nickel content are all below 0.001 per cent and that of all other heavy metals is less than 0.01 per cent (*2*). The silica can be purified by distillation of an organic compound, such as ethyl silicate, which is hydrolized to give a silica gel (Brit. Pat. 498,556). Suitable proportions of the oxides (depending on the required color) are mixed with the silicon compound, which is then hydrolized and the mixture dried and pulverized. Useful luminescent materials can be prepared in which the ratio of SiO_2 to metal oxides differs widely from that indicated by the orthosilicate formulas, Zn_2SiO_4 and Be_2SiO_4. Materials in which the proportions vary as follows have been patented (Brit. Pat. 5131584):

ZnO	10—60%	SiO_2	11—88%
BeO	1—40%	Mn	1—15%

The dry powder is then fired in a silica vessel to a temperature between 1,000° and 1,250° C., held there for up to two hours, and finally cooled, either in air or by immediate quenching in cold water. The precise details of this heat treatment have a considerable effect on the emission spectrum and the phosphorescent behavior of the resulting material. It is therefore necessary to control them as closely as possible, and to ensure that the whole of each batch reaches the same temperature in the furnace.

The material is then ground to the desired size, and in some cases a second firing may be given after the grinding to restore the efficiency. If this is done, special care must be taken to avoid sintering of the powder. Various special techniques have been suggested for avoiding this, such as blowing the powder through the furnace as a cloud of dust (U. S. Pat. 2,196,082).

Magnesium tungstate. No activator is required for this material, which invariably fluoresces with a blue-white color. Its efficiency and stability, however, are very dependent on the purity of the materials used. The magnesium oxide may be purified by standard chemical methods. The tungstic oxide is passed through a cycle, familiar in the preparation of pure tungsten for lamp filaments, in which ammonium tungstate is recrystallized and converted into tungstic acid and the acid dissolved in ammonium hydroxide and recrystallized as ammonium tungstate. The cycle is repeated until the material is sufficiently pure, the limits in this case being of the order of 0.005 per cent for iron and copper (Brit. Pat. 5131584).

The oxide for carbonate of magnesium is mixed as a wet paste with the tungstic acid, dried, ground, and fired at 1,000° C. for one hour (Brit. Pat. 469,732). As in the case of the silicate, a second firing may be necessary after the material has been ground to size.

Zinc sulphide: copper. Pure amorphous zinc sulphide is first obtained by precipitation with hydrogen sulphide from a purified zinc solution. The tolerated amounts of heavy metal impurity are very much smaller than for the silicates, quantities of 0.0001 per cent of iron or nickel having a marked effect on the luminescent characteristics. The dried precipitate is then mixed with about 2 per cent of sodium chloride and 0.1 per cent of copper chloride (Brit. Pat. 550,800). The mixture is fired in an atmosphere of nitrogen for two or three hours at 1,100° C., after which any sodium chloride remaining is washed out with water. The resulting material has a strong green emission, while its phosphorescent properties will depend on the details of the heat treatment. The role of the sodium chloride in this preparation is to increase the rate of crystallization and to lower the temperature necessary for rapid diffusion of the activator into the lattice. Fluxes of this sort are also used to control the particle size of the product.

Sulphides differ from the other types of phosphore, in frequently exhibiting the emission spectrum of more than one activator at the same time. All zinc sulphides emit a blue band, which can be attributed to interstitial zinc atoms. The distribution of the emitted energy between this and the added activator band is influenced by the concentration of the activator and also by the intensity of the excitation. This causes slight changes in the fluorescent color as the intensity is altered, and similar changes may occur during the phosphorescence, as each band decays independently of the other.

In each of these examples it is essential that both the color and the efficiency of the materials should be constant from batch to batch, because in each case the color is not required for itself alone but as a component of a mixture which fluoresces white. Any changes in either of these factors will necessitate changes in the proportions of the components of the mixture if the white is not to be altered, and such adjustments are most undesirable in a manufacturing process.

CONCLUSION

The techniques for the large-scale production of luminescent materials are still largely experimental, but there can be little doubt that when their development has been completed, they will influence a wide field of chemical manufacturing processes outside their own immediate sphere.

References

1. Review articles: HILL, C. G. A. *Chem. Prod.*, 1944, 7, 43; LEVERENZ, H. W., and SEITZ, F. *J. appl. Phys.*, 1939, 10, 479; RANDALL, J. T., and WILKINS, M. F. H. *Rep. Progr. Phys.*, 1939, 6, 174; REES, A. L. G. *Ann. Rep. chem. Soc. Lond.*, 1943, 39, 73; SEITZ, F., and JOHNSON, R. P. *J. appl. Phys.*, 1937, 8, 84, 186, 246.
2. MARDEN, W. J., and MEISTER, G. *Illum. Eng.*, 1939, 34, 563.

Another Chain Reaction

Katherine Chamberlain
Professor of Physics, Wayne University, Detroit

TWICE IN THE PAST THIRTY YEARS the nations of the world have been placed in situations from which there has been no escape except by war. Now, with the advent of the atomic bomb, the problem of what to do to prevent the recurrence of this takes on an urgency that has never existed before. Time after time we have seen aggressive, organized minorities force large numbers of people to conform to their wishes with disastrous consequences. What the world has never yet seen is an equally well-organized effort on the part of people of good will for constructive purposes.

Professor Smyth's report, *Atomic energy for military purposes,* makes it clear that protection against the destructiveness of the atomic bomb is futile. No countermeasures offer any hope except international agreement by all nations that this instrument shall not be used again for war. The difficulty will be to get the agreement. Moreover, it will take time and meanwhile an international race for atomic bomb supremacy may get started that will leave each country no alternative except to inflict upon its citizens the waste of human and material resources required to meet this threat. In addition to agreement by the governments of the world, a very extensive program of education will be necessary to insure the support of the governed if enforcement is to be practical.

It is clear that the leaders in the development of the atomic bomb are fully aware of the potentialities of what they have brought into being and are doing everything possible to keep the race for supremacy from starting. On the part of the rest of us scientists, however, two attitudes of mind are quite common, both of which seem to me equally to be regretted. The first of these is represented by deep dismay, coupled with a generally hopeless feeling that there is nothing that we can do about it. The second expresses the conviction that scientists must pursue their unfettered way in quest of truth regardless of consequences and that responsibility rests elsewhere to prevent dire results. Moreover, the vastness of great research teams may confer on many of the individuals who participate an anonymity that robs them of their sense of personal responsibility.

The successful outcome of the recent effort to release atomic energy for destructive purposes represents the most extraordinary example of cooperation under the guidance of talented leadership that the world has ever known. The outstanding success of the enterprise appears to be due primarily to the ability of the leadership coupled with the urgency of war and the possession of unlimited resources. By all odds the most important element was the leadership.

It has been my privilege to see several of the people who have contributed to the development of our knowledge of radioactivity at sufficiently close range to be quite certain that a group less inclined to present the world with this means of destruction would be difficult to imagine. To the very great, physics is still natural philosophy, and the search for truth for its own sake is very common. Heretofore, it has always been the highest compliment that could be paid a scientist that he sought the truth without fear or favor. But, now, a moral dilemma of appalling proportions has been injected into the search. Is love of truth to be paramount, or love of mankind? Is the immediate advantage of one's own country to be the primary consideration or the welfare of the world? Will man be equal to this great responsibility that he must now assume? The idea is not new that he sows the seeds of his own destruction when he seeks to usurp power that transcends his wisdom.

If something analogous to a chain reaction could be set off by the scientists of the world to arouse people generally to an understanding of the necessity for an international agreement, world-wide and implemented with power to enforce its dictates, we might see an aroused and determined public demand the laws that are needed. This is in no sense a proposal that we scientists should become the self-appointed guardians of civilization. But, as the group that is in the best position to appreciate the disastrous potentialities of atomic energy without adequate control and as one not likely to be carried away by hysteria or panic, we should be able to arouse other people to the realization that nothing else greatly matters if this problem is not solved.

As a first step, it seems appropriate to inquire whether the great laboratories that are likely to be the fountain heads of continued nuclear research cannot make public a statement of policy to reassure people generally that the millions they contemplate spending do not mean more bombs or a blind lack of sense of social responsibility. Anyone who is acquainted with them knows all this perfectly well, but the great majority of people do not know them and will certainly be much more inclined to cooperate if convinced that they are not rather sinister places that should be feared.

The directors and senior research staffs of these laboratories probably do not include more than one hundred persons in the entire world. Moreover, the lines of international communication are at their best in science. Most of these people are personally acquainted with one another, which is an enormous aid to understanding. If they were to publish an agreement that no further investigations involving release of atomic energy for military purposes would be carried on in the laboratories under their jurisdiction, the case against the atomic bomb would have the direct sanction of very exalted authority.

Granting that such an agreement by existing laboratories might result in the attempt to establish others with large government subsidies, these will be nothing but warehouses for apparatus unless they can be staffed by very able scientists. Such scientists are not likely to be attracted by offers, however attractive, that exist only because the established laboratories have decided that certain types of research are not in the public interest. Moreover, without very able scientists to coordinate the work, interpret the results, and keep up morale in these dangerous pursuits, it is very doubtful whether they could function effectively. Actually, it is a fair inference that such control is already under way, but the publication of it might be an enormous aid in achieving understanding.

The objection may be made that it is impossible to separate the constructive and destructive aspects of atomic research. And, yet, this has been done very effectively in the case of electricity. While we rarely want to release its more titanic aspects in our laboratories, control of its tremendous forces is so well understood that the General Electric Company did not hesitate to produce the beautiful spectacle of man-made lightning at the Century of Progress before large crowds.

Neither does the argument seem quite sound that war can now be made so terrible that no country would dare to embark on it with atomic bombs. Fear of consequences has never permanently deterred man from anything, and panic does strange and dreadful things to the character and judgment even of the best of us. If the atomic bombs are ready and war seems imminent, might not a country that is fundamentally peace loving succumb to the temptation of using them first?

It will mean a lot if society can so order things that it will not need to call upon large numbers of its young men in the atomic age to stand guard over the stratosphere. It will mean even more if it will be possible to stop the spread of fear, suspicion, and hate in the world that a race for atomic bomb supremacy will precipitate.

When scientists confined their attention to things like falling bodies, the origin of species, or the motions of the planets, we could afford to smile over the belief of some of their contemporaries that they were a menace to society. But when we seek to recreate elements that possibly had to disappear by radioactive disintegration before the earth originally could become habitable and to release energy at rates never before experienced by man at distances less than that to the sun, we know that we are setting loose forces that are fearful to contemplate. Freedom to carry on such investigations is accompanied by a very terrible responsibility. Very clearly it must rest on all who contribute in the slightest particular, directly or indirectly, to atomic research. This is a plea that those of us who had no direct part in the development of the bomb help those who had to carry this responsibility.

Scientists have always lost control over their inventions and discoveries as soon as the creative phase was completed.

Can't we act while there is still time?

Can't the leaders in these great laboratories in which nuclear research will be carried on state publicly their opposition to further work on those aspects that need to remain military secrets?

Can't all of us in science enter the atomic age with full realization that scientific freedom must be redefined?

Can't we all make a concerted effort to help to educate people generally regarding atomic energy until the thousands of ourselves become the millions who must be convinced if international agreements are to be permanently enforced?

As evidence of our good faith, can't we get Congress to close those plants at Oak Ridge and at Hanford and keep them closed until plans for the control of their products can be worked out?

Then, can't we go to the rest of the world in the same spirit that has made collaboration in the physical sciences so effective in the past and offer all nations complete cooperation while we work to develop the constructive uses of atomic energy and the federation for world security—together?

Science Legislation

Further Notes on Science Legislation

Robert Chambers
New York University

A welcome feature in *Science* is the periodic publication of items of interest concerning the pending science legislation in Congress. The fact that such legislation was being contemplated was brought last September to the attention of workers at the Marine Biological Laboratory at Woods Hole when questionnaires were distributed by Dr. Howard Meyerhoff of the AAAS for the purpose of securing information as to the desires of scientists regarding the organization of a National Science Foundation. A widespread response in favor of the establishment of such a foundation was expressed, together with the conviction that the control of the Foundation should be primarily by the scientists themselves. Such a form of organization appeared to be best expressed in the original Magnuson Bill and not in the original Kilgore Bill, which placed the control in the hands of a single administrator appointed by the President.

During October, hearings on Science Legislation were instituted by Senator Kilgore, who invited the participation of Senators Magnuson and Pepper and their subcommittees and also Senator Fulbright. Approximately one hundred witnesses, including scientists and other experts, appeared at the hearings, and over one thousand printed pages of testimony were taken. The Union of the American Biological Societies and the American Biological Society took active part in inviting biologists and in urging that the biological sciences be considered separately from the medical sciences. One full day was reserved for testimony on the biological sciences, and we now have assurances from both Senator Magnuson and Senator

Kilgore that in their revisions biology as distinct from the medical sciences will be considered on a par with the physical, chemical, and mathematical sciences.

Concerning the top administration of the proposed Foundation, the opinion of scientists in general has been one of favoring a board of scientists. This has persisted, in spite of the fact that some of the testimony at the hearings presented cogent reasons in favor of a single Administrator responsible to the President and the Congress.

Subsequently, the Letter to the President, drafted by the Bowman Committee and endorsing the principles presented in Senator Magnuson's Bill, was drafted and widely published (*Science*, 1945, **102**, 545). Some regarded the stand taken in the letter as uncompromising. This would be most unfortunate, since both the Magnuson and Kilgore Bills are still in committee and open to revision for the cooperative formulation of a bill which will be acceptable to governmental procedure without loss of the prerogative of free initiative in scientific research. An uncompromising attitude, fancied or real, at this stage, may jeopardize the enactment of a measure so overwhelmingly approved of in the October hearings in Washington. More recently a Committee for a National Science Foundation has been formed (see *Science*, 1946, **103**, 11, 45) claiming to sponsor no one bill but to stand for a general cooperative effort toward the realization of a Federal organization for the advancement of science in this country. The original Kilgore Bill contained several provisions unacceptable to scientists at large. The recent draft, S. 1720 (printed in *Science*, 1946, **103**, 39) is a complete revision in which most of those provisions have been eliminated. This draft is presented by the Subcommittee as a preliminary report for further comment before it is reported out of committee.

It is suggested that this draft serve as a basis for further discussion toward the enactment of a bill acceptable to scientists and Congressmen alike.

The publication of the Letter to the President by the Bowman Committee has been most valuable in awakening scientists to the implications involved in setting up a National Science Foundation. Its endorsement by so many prominent scientists has presented to the Congress and to the country how jealously the scientist maintains his conviction that scientific endeavor shall, under no circumstances, be trammeled or regimented by government or by any individual.

At the same time it behooves us to assist in the formulation of a bill which comes within the framework of accepted constitutional procedure. There should be no need for dividing into two camps. We have every right to differ on details, but the proposition is so big that we surely can agree on the big principles for the embodiment of a federally sponsored foundation in which adequate freedom of scientific enterprise will be maintained.

Several suggestions come to mind for the appointment of the top administration of the proposed Foundation. One is that two panels of names be prepared by the National Academy of Sciences, which should set up a mechanism for receiving nominations from accredited scientific societies. The President might then appoint the Administrator and the Advisory Board from the two panels. It is hoped that amendments now under consideration will achieve the desired result, namely, a National Science or Research Foundation the operations of which will be guided by the experience and wisdom of scientists, and in which scientists themselves will be induced to take responsibility commensurate with their experience and wisdom.

S. 1720 *vs.* S. 1777

Howard A. Meyerhoff

Executive Secretary, AAAS, Washington, D. C.

S. 1720 IS UNDERGOING FINAL REVISION and redrafting, and there is every reason to believe that the bill which reaches the floor of the Senate will be acceptable to the vast majority of scientists. The bill was distributed widely in Subcommittee Report No. 7, with an invitation to submit constructive suggestions. It was evident that S. 1720 had effectively met the more serious criticisms that had been directed at S. 1285 and S. 1297, and that opposition to S. 1720 as a whole on the part of any group would merely be regarded as obstructionism. At the same time, despite the marked improvement in the new draft, several minor provisions and at least two major ones called for further discussion.

For this purpose Senator Elbert D. Thomas, of Utah, arranged a preliminary meeting at which Messrs. Bush and Bowman discussed differences with Senators Kilgore, Magnuson, and Thomas. A more formal meeting was held on 23 January with Senator Saltonstall presiding. Although some question has arisen regarding the propriety of giving representatives of the Committee Supporting the Bush Report a hearing practically to the exclusion of other interested groups, the procedure was expedient and practical. The Committee for a National Science Foundation, which draws more widely among scientific fields for its support, had indicated its acceptance of the major provisions of S. 1720; hence, it was important to get the viewpoint of the Committee Supporting the Bush Report, which had at one time entertained the idea of opposing any bill except S. 1285.

Although it is unsafe to predict the changes which will be made in the provisions of S. 1720 by the time it is reported out of committee, there is now unanimity among scientists regarding the need for a National Science Foundation. The Committee Supporting the Bush Report recognized that the President cannot be restricted in his appointive powers and is satisfied that a strong board which may submit nominations for the post of Administrator, and which can check or balance the Administrator at crucial times, will adequately protect scientists from possible political control or domination.

Social Science

This Committee is still convinced that the Social Sciences should not be included in the Foundation, but chiefly because of the fear that lack of definition and vagueness in stated aims and functions in the field may militate against the passage of the bill. The fact is that the social scientists, through the Social Science Research Council, are ready and willing to define their field, their aims, and their functions and will welcome the opportunity to accept the same rigorous standards as apply in the physical, biological, and medical fields.

Patents

Even on the issue of patents it is unanimously agreed that the patent provisions of S. 1720 are basically sound; that they do not involve patent reform or new legislation; and that the purpose of the bill to standardize patent policy within the government agencies is worthy of support. Here again the fear is expressed that such provisions will arouse opposition which will jeopardize the entire bill.

Remaining Question

Whether or not these fears are well founded, the question still remains: Should desirable elements be excluded in committee on the chance that they may generate some opposition on the floor? Any answer to this question must be qualified. If such provisions are irrelevant, it is foolhardy to load the bill with them. If they expose the bill to a serious risk of defeat, they may wisely be sacrificed. But if they are desirable provisions, the political expediency of scrapping them before the existence of opposition is known or its strength ascertained is doubtful.

At this moment other hazards appear more serious than these. The Senate is becoming increasingly preoccupied with other matters, and the interest which was evident last fall has waned. The House is scarcely aware of the proposed legislation; and with sentiment for economy rising, it can easily consign the bill to painless death in committee. There is comparatively little public pressure upon Senate or House to pass such legislation, and even though many scientists have written interested Senators, the impression given has been one of internal dissension, which provides a dubious background for Congressional action.

A New Hazard

Without question the most serious hazard which must be faced comes unexpectedly from a new quarter. On 30 January Senator Willis (Ind.), with Senators Hart (Conn.), Hawkes (N. J.), Hickenlooper (Ia.), Smith (N. J.), Stanfill (Ky.), Wiley (Wis.), and Young (N. D.), introduced S. 1777 into the Senate. The Bill proposes that the President appoint a self-perpetuating committee of 50 from a list of nominees submitted by the National Academy of Science for the purpose of administering a limited program of scientific activity. This solemn proposal ignores the work performed by Vannevar Bush and his committees; by Senators Kilgore and Magnuson and their respective subcommittees and staffs; by more than 100 scientists who prepared and presented testimony at the October hearings; by more than 100 scientific organizations which have painstakingly studied the bills already before us; by the Committee Supporting the Bush Report, which has ardently worked in behalf of an excellent report, which S. 1777 would at best duplicate; by the Committee for a National Science Foundation, which has had the single aim of assuring the creation of a Foundation based upon studies already made.

After all this work has been done eight Senators, who have had no previous connection with science legislation and who have offered no evidence of knowing anything about it, ask their 88 colleagues to consider a $100,000 appropriation to appoint a new committee of 50 to make "an initial report and recommendation to Congress." This has already been done *gratis*, by the eminent professional men who have contributed to the final draft of S. 1720.

It is to be hoped that scientists will not leave the sponsors of S. 1777 long in doubt regarding the value they place upon this bill.

Statement by Senator Willis Introducing a Bill for a National Science Foundation

. . . There is a special reason at this time for the introduction of this bill. For over a year, bills providing for federal aid to science in some form have been in Senate committees. On October 8, 1945, three subcommittees of Military Affairs and Commerce joined in holding hearings on proposed legislation to create a National Science Foundation. Chief among the bills so considered are S. 1297 and S. 1285, referred to because of their sponsorship as the Kilgore and Magnuson bills.

In the hearings on these bills, the joint subcommittees called 100 witnesses and printed about 1,000 pages of testimony, but no substantial agreement on a proper bill came from these labors. In the end—toward the close of the last session before the Christmas recess—*a new bill,* S. 1720, was introduced in an effort to reach an agreement to report a bill.

The reason for these difficulties is plain to anyone who will read the pending bills and the hearings upon them. Fundamental division of opinion exists upon the far-reaching character of these bills as they relate to political controls over science, over the form of administrative structure as between a directing board or a single head, over patent and national defense features of the bills, over the way in which federal money would be distributed and over the effect of such a distribution on science itself. I could continue with these reasons, but it is not my purpose at this time to go into the merits of this legislation. I merely wish to point out the situation as we now find it in these committees.

The chief reason for controversy is that the pending bills offer no real difference in approach to this very important problem. Both of the major bills, S. 1297, S. 1285, together with the entirely new bill, S. 1720, coming from the same sponsor of S. 1297 (Mr. Kilgore) involve a large government agency, politically responsible and politically controlled. No alternative to the philosophy of state-controlled science has been before the joint committee.

Scientists who spoke at the hearings had no alternative approach to consider. Except for the one problem of whether there should be a board or a single head in charge of this vast science program, almost no testimony was produced on the vital question of the administrative structure and methods of operation of a National Science Foundation. The chief question before the witnesses was whether the federal government should aid science; and of course most of the witnesses approved the proposal for federal aid. Few of the witnesses considered how this was to be done. Few spoke of the specific provisions of the bills. I doubt if the scientists who appeared (many of them eminent men) would be for any bill which means government control, political interference, or restrictions on the freedom of scientific thought and action. The pending bills do involve those questions very materially but few witnesses turned their opinions in that direction largely because there was no other bill to raise the question of a different approach to federal aid of science.

We are now in this position: that the pending bills have been rewritten and revised many times and no agreement has been reached on any one of them. In these circumstances, an entirely new bill, S. 1720, was introduced a few weeks ago. This new bill makes the same approach to the problem as did the previous bills; and it contains many new and controversial features.

In these circumstances the committees in charge of the hearings must undoubtedly reopen the hearings for further testimony. Certainly the committees could hardly report out a new bill claiming the support of testimony taken on previous and different bills—especially when the new bill raises questions on which controversy exists and on which there is an absence of testimony on the crucial point of administration.

Since a renewal of hearings will and certainly should be undertaken, another means of accomplishing this aid to science should be put before the committee to provide an alternative approach to this problem.

That is the purpose of the bill I am now introducing. The whole subject of federal aid to science is far too important to be settled without exploring all proper methods. The bill I now offer is based on proved American experience which has developed American science from its infancy to the pinnacle of leadership. It safeguards the independence of science at the same time that it provides for federal financial support of science. It eliminates political control far more than does any of the pending bills. It leaves the scientist free to determine the needs of science and yet arranges to correlate science with the development of the nation. It fosters worldwide scientific cooperation.

The bill itself is a simple one. It provides for the formation of an independent corporation by 50 of the most distinguished leaders in the nation, scientists and laymen. With full powers, properly safeguarded, this corporate body of distinguished men and women is entrusted with the responsibility of evaluating the changing needs of scientists, reporting to Congress, and allocating the funds Congress appropriates.

For eighty years the National Academy of Sciences has functioned quietly and efficiently on the same principle. Since 1917, the National Research Council, associated with the Academy, has done likewise. The war record of these two distinguished scientific bodies is worth any Senator's study on the question of federal aid to science. Without the Academy and the National Research Council, the work and achievements of the OSRD, the WPB and other agencies dependent on science would have been severely handicapped. The Red Cross, which as we all know has distinguished itself at home and abroad, in peace and in war, is organized on the same principle as embodied in this bill. Such institutions as the Academy and the Red

Cross are eloquent proof that the principle of an independent body, free of government interference and free of political control, is a sound and desirable one.

Mr. President, that is the principle incorporated into this bill for federal aid to science which I now offer. I ask that it be referred to the Committee on Commerce which has other science aid bills before it. There I hope it will receive proper consideration for the splendid alternative it offers to the present controversies over federal aid to science.

S. 1777

A bill to assist the agencies of scientific and technological education and the development of the Nation and to establish a National Science Foundation:

DECLARATION OF POLICY

SEC. 1. Congress hereby recognizes that the energetic development and application of the Nation's scientific and technological resources are essential to progress and prosperity. The purpose of this Act accordingly is to aid other agencies in advancing the Nation's scientific and technological education and development, and in particular to supplement moneys now and hereafter forthcoming from private sources, by such appropriations as Congress, acting upon the advice of the National Science Foundation, herein created, may make available.

ESTABLISHMENT OF INDEPENDENT OFFICE

SEC. 2. There is hereby created, as an independent agency of the Federal Government, the National Science Foundation, a corporation, the initial members of which shall be fifty (50) distinguished men and women representative of all sections of the Nation, recognized leaders in the fields of fundamental science, social sciences, medicine, engineering, and education, and lay persons of recognized standing in public affairs, selected solely on the basis of established records of distinguished service without reference to any political, social, or religious factors. The President of the United States shall select and appoint these initial members of the Foundation from among nominations requested by him from the National Academy of Sciences for those fields within the province of the Academy and from recognized National organizations in those fields outside the province of the Academy.

SEC. 3. The National Science Foundation shall consist of not more than fifty (50) members, and the said corporation hereby constituted shall have power to make its own organization, including its constitution, bylaws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the division into classes; to appoint a chief executive officer and a staff and to pay their salaries from moneys that may be available for that purpose; and in general to do all other matters needful or usual in such institution, and to report the same to Congress annually.

SEC. 4. (a) The National Science Foundation shall hold meetings at such times and places in the United States as it may designate, and the Foundation shall examine into and report to Congress annually upon the monetary needs of American institutions devoted to higher education and the pursuit of knowledge in regard to research and training in all departments of science as well as aid by means of scholarships and fellowships in these departments, and disburse such funds as Congress may provide.

(b) In matters relating to the departments of science represented in the National Academy of Sciences (the physical and biological sciences and mathematics) including basic medicine and engineering the Foundation shall in discharging its functions request advice from the Academy (an agency incorporated by Congress, March 3, 1863, to advise Government in matters of science and art). With regard to matters outside those fields within the province of the Academy, it shall request the advice of recognized national organizations in the appropriate field. The Foundation, however, shall not be obligated to follow advice so requested if it is contrary to its own judgment.

SEC. 5. The Foundation shall foster the maximum publication and dissemination of scientific discoveries and technical information of scientific value and may publish or arrange for publication of such discoveries and information.

SEC. 6. The Foundation is hereby authorized with the approval of and through the Secretary of State to cooperate in any international research activities consistent with the purposes of this Act and to conclude agreements with foreign governments or agencies thereof facilitating the acquisition, dissemination and exchange of scientific and technical information. The Foundation shall, from time to time, in cooperation with the State Department and other interested governmental agencies appoint from nominees of scientific and professional associations official representatives to accredited international scientific congresses and meetings and defray the expenses of such representatives.

SEC. 7. The National Science Foundation is authorized and empowered to receive by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: provided, however, that Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Science Foundation.

SEC. 8. Neither the Foundation nor any of its members shall receive any compensation whatever from Congress for any of the services which it performs, but the actual expenses incurred in the discharge of its duties, including travel and subsistence of members in discharge of their duties, may be paid from appropriations which may be made for the purpose.

SEC. 9. Congress shall have the right to repeal, alter, or amend this Act at any time.

SEC. 10. In order to provide for the organization of the Foundation and the making of an initial report and recommendation to Congress there is hereby appropriated the sum of one hundred thousand dollars ($100,000).

News and Notes

Dr. Carroll C. Pratt, professor of psychology on leave of absence from Rutgers University, has been made Ordinarius Professor at the University of Ankara by the Turkish Ministry of Education. This is the second time this rank has been conferred at Ankara.

Col. Walter M. Scott, chemist and authority on cotton textile problems, has been made director of the U. S. Department of Agriculture's Southern Regional Research Laboratory at New Orleans, according to an announcement by Washington officials on 2 January 1946. Dr. Scott, who will assume his new duties about 1 February, succeeds the late D. F. J. Lynch, who directed the laboratory from the time of its establishment until his death a few months ago.

Lt. Herbert S. Bailey, Jr., USNR, has been appointed scientific editor of the Princeton University Press, effective 1 February.

A lecture series, "Recent Advances in Botany," is now being given at the Brooklyn Botanic Garden. Dr. Ray F. Dawson, of the Department of Botany, Columbia University, was the first speaker, on 12 December 1945, his subject being "Grafting as a Method of Study of Drug Production in Plants." On 9 January Dr. F. E. Denny, of the Boyce Thompson Institute, spoke on the "Control of Dormancy in Plants." Forthcoming in the series are: 13 February: "Plants and the Material Basis of Civilization," Dr. E. W. Sinnott, director of Sheffield Scientific School, Yale University; 6 March: "Effect of Light Periods on Flowering," Dr. C. B. Link, horticulturist, Brooklyn Botanic Garden; 3 April: "Plant Viruses and the Nature of Virus Diseases," Dr. B. M. Duggar, University of Wisconsin and Lederle Laboratories.

Dr. Elton F. Paddock has joined the genetics group of the Department of Zoology and Entomology at the Ohio State University, with the rank of assistant professor. He will teach genetics and cytogenetics.

Dr. J. F. T. Young has been promoted to the rank of professor and head of the Department of Physics at the University of Manitoba, Winnipeg, Canada, in succession to Professor Emeritus Frank Allen, the founder of the department, who has retired after 40 years of service with the University.

Dr. Frank Harrison, associate professor of anatomy of the College of Medicine and the School of Biological Sciences of the University of Tennessee, has been appointed professor of anatomy and chief of the Division of Anatomy. He will assume the post on 1 April 1946, succeeding Dr. K. B. Corbin, who at that time will become associated with the Mayo Clinic.

Recent Deaths

Dr. Edwin Stephen Goodrich, 77, died in his home at Oxford on 6 January. He was a Fellow of Merton College, Oxford, and also Linacre professor of zoology and comparative anatomy at the University Museum, Oxford. Dr. Goodrich received the Linnean Gold Medal in 1932 and the Royal Medal of the Royal Society in 1936. He was the author of several works on zoology.

Dr. C. E. McClung, 75, emeritus professor of zoology and former director of the Zoological Laboratory, University of Pennsylvania, and acting head of the Department of Biology at Swarthmore College, died suddenly on 17 January in Swarthmore, Pennsylvania.

Technical Papers

Characterization of Pectin

Claude H. Hills and Rudolph Speiser
Eastern Regional Research Laboratory,[1] *Philadelphia*

The molecule of the natural high polymer, pectin, is composed principally of anhydrogalacturonic acid residues, partially methyl esterified and linked together to form a long chain. Nongalacturonide materials, galactan and araban, may constitute one-third or more of the weight of the pectin. As has been shown by Schneider and Bock (*3*), the characteristic properties of pectin—gelation, film formation, and high viscosity in dilute solution—derive from the polygalacturonide chain; the nongalacturonide constituents or "ballast materials" act mainly as diluents.

In characterizing pectin by chemical means it has been the custom to give the ester content, computed as methoxyl and expressed as per cent by weight of the whole sample. Alternatively, the related quantity, neutralization equivalent, has been used for the same purpose. It is the object of this communication to demonstrate that because of variability in the proportion of nongalacturonide material neither the weight per cent of methoxyl nor the neutralization equivalent is adequate for the characterization of pectin, and to show that the properties of pectin are better described by the galacturonide content and the degree of esterification of the galacturonide chain.

Recently considerable interest has developed in low-ester pectin. De-esterification progressively increases the acidic nature of pectin and hence its reactivity with metallic ions. Beyond a certain stage in the de-esterification, the pectin is able to form stable gels with polyvalent cations such as calcium. These gels have promise of commercial importance.

It has not been recognized previously that the galacturonide content of a low-ester pectin may be greatly influenced by the method of de-esterification. Fig. 1a shows that in de-esterification by acid the methyl ester groups and the nongalacturonide materials are removed at approximately the same rate, while in enzyme de-esterification (Fig. 1b) the nongalacturonide content is reduced only slightly. The methoxyl content and neutralization equivalent of low-ester pectins produced by these two methods are not, then, in general comparable, because the pectins contain different amounts of diluent.

On prolonged acid treatment the nongalacturonide content of the pectin sample represented in Fig. 1a was reduced to 0.9 per cent. The corresponding average residue weight is 178 and thus approaches closely the theoretical limit of 176, the residue weight of anhydrogalacturonic acid. The fact that this material was of high molecular weight (at least 30,000 as indicated by viscosity and gel formation) means that probably none of the nongalacturonide constituents are situated in the pectic acid chain. This confirms the conclusion reached by Schneider and Bock (*3*) from entirely different experiments that the main pectin chain consists exclusively of anhydrogalacturonide units.

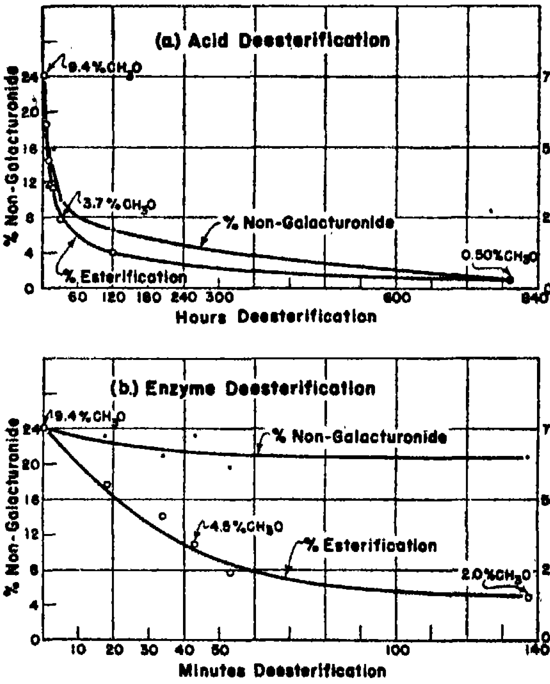


Fig. 1

As stated above, a characteristic property of low-ester pectins is the formation of ionic-bonded calcium gels. The extent of de-esterification necessary for gel formation with calcium ions cannot be defined accurately by either the neutralization equivalent or the methoxyl value, since both quantities are affected by variation in the nongalacturonide materials present. This fact is illustrated by the data in Table 1. Sample A, a non-de-esterified pectin, did not form a stable calcium pectinate gel, although it had a lower methoxyl value than sample B-1, which did form a gel. This anomaly is explained by the difference in the per cent esterification of the two samples. It may be observed that calcium pectinate gels containing 35 per cent sugar are formed only when the degree of esterification of the polygalacturonide chain is less than 50 per cent.

---

[1] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

Data for samples A and A-1 show that by removal of nongalacturonide material the methoxyl value and the neutralization equivalent may be changed greatly, while the degree of esterification is reduced only slightly. Clearly, the increase in the jelly grade of pectins upon mild acid de-esterification observed by Baker and Goodwin (*1*) may be caused in part by the removal of inactive constituents and the consequent increase in galacturonide content.

TABLE 1

DATA CHARACTERIZING TWO SERIES OF ACID—DE-ESTERIFIED PECTINS

Sample No.	Description	Ca-pectinate gel formation*	Per cent esterification	Per cent CH_3O	Neut. equiv.	Per cent galacturonide
A	Commercial apple pectin	None	68.0	6.57	990	57.8
A-1	Sample A purified†	None	66.7	8.06	789	71.1
A-2	Sample A acid de-esterified	None	50.6	6.61	476	78.3
A-3	Sample A acid de-esterified	Strong	38.5	5.23	370	80.1
B	Purified apple pectin†	None	74.2	9.36	952	76.0
B-1	Sample B acid de-esterified	Weak	45.2	6.78	891	85.7
B-2	Sample B acid de-esterified	Strong	24.2	3.70	269	89.1

* Calcium pectinate gels, containing 35 per cent sugar, prepared by method of Hills, White, and Baker (Hills, C. H., White, J. W., Jr., and Baker, G. L. *Proc. Inst. Food Tech.*, 1942, 47–58).

† Purified by dissolving in water, adding 5 per cent conc. HCl by volume, immediately precipitating with ethanol, and washing with ethanol until free of chlorides.

The degree of esterification and the galacturonide content may be calculated readily from the methoxyl value and titration data. Each anhydrogalacturonide residue in the chain may be considered to contain either a free carboxyl or a methyl-esterified carboxyl group.[3] The number of moles of free carboxyl groups (N) per gram of pectin may be determined from the alkalinity of the ash and the amount of alkali required to titrate an aqueous solution of pectin to pH 7.5 (*4*). The number of moles of methyl-esterified carboxyl groups may be determined by methyl ester analysis (*2*) and the formula

$$Z = \frac{\text{wt. per cent } CH_3O}{3100}$$

From these two quantities one may compute the per cent galacturonide, the per cent nongalacturonide, the neutralization equivalent, the per cent esterification of the galacturonide chain, and the average residue weight by the relations

$$\text{Per cent galacturonide} = (176\,N + 190\,Z) \times 100$$

$$\text{Per cent nongalacturonide} = 100 - \text{per cent galacturonide}$$

$$\text{Neutralization equivalent} = \frac{1}{N}$$

$$\text{Per cent esterification} = \frac{Z}{Z+N} \times 100$$

$$\text{Average residue weight} = \frac{1}{Z+N}$$

In view of these considerations it is suggested that, instead of per cent methoxyl by weight, the per cent galacturonide and the per cent esterification of the galacturonide chain be used in the characterization of pectin.

References

1. BAKER, G. L., and GOODWIN, M. W. *Del. Agric. Exp. Sta. Bull.*, 1941, No. 234.
2. HILLS, C. H., OGG, C. L., and SPEISER, R. *Ind. eng. Chem.* (Anal. ed.), 1945, 17, 507.
3. SCHNEIDER, G., and BOCK, H. *Ber.*, 1938, 71B, 1353.
4. SPEISER, R., HILLS, C. H., and EDDY, C. R. *J. phys. Chem.*, 1945, 49, 328.

---

[3] The close agreement between the decrease in methyl ester groups and the increase in carboxyl groups observed on de-esterification of pectin indicate that, for the purpose of calculation, it is valid to consider that all the ester groups are methyl. In any case, if the araban or galactan occurred as ester groups, the decrease in the total carboxyl content would be negligible because of their high molecular weight.

Inhibition of Growth of *Mycobacterium Tuberculosis* by a Mold Product—the Effect on Pathogenic Human Tubercle Bacilli[1,2]

ISADORE E. GERBER and MILTON GROSS

Hudson County Tuberculosis Hospital, Jersey City

A mold product capable of inhibiting the *in vitro* growth of a rapidly proliferating nonpathogenic strain of *M. tuberculosis* was described in a previous report (*1*). The present study is concerned with the *in vitro* activity of this mold product against pathogenic human tubercle bacilli.

For convenience the material has been named, temporarily, mycocidin and a working unit of activity has been established. The strength of a mycocidin preparation is determined as follows: A standard culture is prepared consisting of a 5-day-old pellicle of the nonpathogenic strain of *M. tuberculosis* var. *hominis* (American type culture collection No. 607) on Long's synthetic liquid medium. The standard inoculum, which measures approximately 2 × 2 mm., is taken from the periphery of this pellicle. With some experience nearly similar fragments are usually obtainable. Test tubes of 1 in. in diameter containing 5 ml. of Long's synthetic medium are set up in series and mycocidin is added in varying concentrations. The final volume is made to 6 ml. The inoculum is floated

---

[1] From the Laboratories of the Hudson County Tuberculosis Hospital, Jersey City, New Jersey.

[2] The authors wish to acknowledge thankfully the accurate and capable assistance of Lyetta Yogman.

on the surface of the medium and the tubes are incubated at 37.5° C. for 5 days. The extent of growth of the inocula is recorded daily and compared with controls. A unit of mycocidin (M-unit) is defined as that amount of the preparation of the mold extract per milliliter of Long's synthetic medium which will completely inhibit the growth of the standard inoculum.

TABLE 1

Experiment number	Extract number	Concentration range (M-units per ml. Long's medium)	Strain of tubercle bacillus	Inoculum	Length of exposure of tubercle bacilli to mycocidin in Long's medium	Treated bacilli replanted and incubated for:	Minimal concentration necessary for complete inhibition (M-units per ml. Long's medium)
1	30	1.70 –2.66	RES	Large clumps	7 days	57 days	1.700
2	30 PD	0.13 –1.30	RES	Large clumps	7 days	44 days	0.515
3	30 PD	0.125–1.25	RES	1 mg. in suspension	7 days	50 days	0.625
4a.	34	0.20 –2.00	RES	1 mg. in suspension	18 hours	60 days	0.833
b.					3 days	58 days	0.625
c.					5 days	56 days	0.415
5	34	0.20 –2.00	CS	Large clumps	7 days	55 days	0.625

The human pathogenic tubercle bacilli employed in this experiment consisted of two strains which were isolated from patients with far-advanced pulmonary tuberculosis. The bacilli were grown on Petragnani's solid medium. Both strains are highly pathogenic for guinea pigs as evidenced by the fact that an inoculum of 0.0001 mg. of the bacilli suspended in normal saline and injected into the groin of guinea pigs produces diffuse miliary tuberculosis within 6 weeks.

The pathogenic human tubercle bacilli were treated with the mold product in the following manner: Tubes containing 5 ml. of Long's synthetic medium were set up in series. To one group mycocidin in varying concentrations was added. The other group served as a control. The final volume was made to 6 ml. Clumps or suspensions of tubercle bacilli were added to the tubes containing the extract as well as the controls. These were then incubated for periods varying from 18 hours to 7 days. The bacilli were centrifuged, washed with saline, recentrifuged, and resuspended in saline. The organisms were then tested for viability either by culturing on Petragnani's solid medium or by inoculation into guinea pigs.

The culture experiments are summarized in Table 1. As will be noted in Experiments 1, 2, and 5, the tubercle bacilli used consisted of clumps weighing from 1 to 2 mg. exposed to mycocidin in the Long's synthetic medium for a period of 7 days. The growth of the recultured bacilli was observed weekly, the final reading being made at periods of 44 to 57 days. Experiment 1 was a pilot experiment, and it soon became evident that more than the minimal amount of mycocidin necessary for complete inhibition of the organism had been used. In subsequent experiments, lower concentrations of mycocidin at graded intervals were employed. The minimal amount necessary for complete inhibition of growth was found to be approximately 0.515 M-unit per ml. of liquid medium for the RES strain and 0.625 for the CS strain. In Experiment 3, suspensions of organisms instead of clumps were employed. These suspensions were made by grinding a weighed quantity of bacilli in a mortar with saline containing several drops of bile. A final concentration of tubercle bacilli in suspension in saline of 1 gram per cent was made. One-tenth of a milliliter, equivalent to 1 mg. of bacilli, was added to each test tube containing the liquid medium with varying concentrations of mycocidin. It was found here, also, that the minimal concentration necessary for complete inhibition was 0.625 M-units per ml. In Experiment 4, the technique was similar to that of Experiment 3. However, the period of incubation was varied. Groups of tubes containing the extract and comparative controls were incubated for 18 hours, 3 days, and 5 days. As can be seen from the table, the minimal concentration necessary for complete inhibition was inversely proportional to the length of exposure of the tubercle bacilli to the mycocidin.

Cultures of the controls in all the preceding experiments showed active growth within 21 days, whereas those of the bacilli exposed to as little as

0.125 M-unit per ml. were still negative. At the time of the final reading all controls showed active, prolific growth, whereas all the cultures of the organisms treated with the minimal effective concentrations were negative. Bacilli that had been treated with less than minimal effective concentrations grew out slowly, the rate of growth being inversely proportional to the concentration of mycocidin to which they were exposed.

The animal experiments performed are summarized in Table 2. One milligram of the organisms of the RES strain in suspension was exposed to mycocidin in Long's liquid medium in the manner described above for periods of 18 hours, 3, 5, and 7 days at 37.5° C. The centrifuged and washed organisms were resuspended in saline and amounts equivalent to 0.1 and 0.5 mg. were injected into the groin of guinea pigs weighing 400–500 gms. Twenty-five animals were used. As can be seen from Table 2, when the organisms were exposed for a period of 3, 5, or 7 days to a concentration of 1 or 2 M-units per ml. and were injected into guinea pigs, the animals failed to develop tuberculosis. When killed 7 or 8 weeks later they were entirely negative on post-mortem examination. With lower concentrations and insufficient exposure, there was only partial inhibition of the bacilli as evidenced by the mild to moderate tuberculosis observed in the animals injected with these bacilli. All control animals showed far-advanced miliary tuberculosis.

Cultural studies and animal inoculations indicate that the mold extract, mycocidin, is both bacteriostatic and bactericidal for the human tubercle bacillus. After exposure to adequate concentrations of mycocidin, the bacilli fail to grow out when replanted on solid medium, and lose their ability to produce tuberculosis in guinea pigs. Since the treated bacilli are thoroughly washed, this cannot be due to adherent mycocidin. In concentration less than minimal, the bacteriostatic property of mycocidin is evidenced by the fact that when the bacilli are replanted on solid medium the rate of growth is slow in comparison to the controls and is inversely proportional to both the length of exposure and the quantity of mycocidin. It was found that 0.5 to 0.6 M-unit per ml. was necessary for bactericidal effect upon 1 mg. of the pathogenic strain of human tubercle bacilli. This would indicate that the pathogenic strains of human tubercle bacilli used in these experiments are about twice as sensitive to the effects of mycocidin as the nonpathogenic variety.

Further experiments are continuing on the isolation and purification of the active principle. The activity of mycocidin against other organisms is also being investigated.

TABLE 2

Extract number	Length of exposure of 1 mg. tubercle bacilli to mycocidin in Long's medium	Concentration of mycocidin in Long's medium (M-units per ml. Long's medium)	Number of guinea pigs	Mg. tubercle bacilli injected into guinea pig	Result
30 PD	7 days	0 (Controls)	4	0.1	All animals died within 28–35 days with diffuse miliary tuberculosis.
		1.0	4		One animal died after 6 days of pneumonia. Two were killed at the end of 30 and 51 days, respectively. One animal still alive at 127 days. No evidence of tuberculosis in any animal.
	18 hours	0	2	0.5	One animal died after 48 days. The other was killed after 54 days. Both animals had diffuse tuberculosis.
		0.2	2		One animal died after 46 days. The other was killed after 54 days. Both animals had diffuse tuberculosis involvement but less than controls.
		2.0	2		Both animals killed after 54 days—moderate tuberculosis present in one animal; other entirely negative.
34	3 days	0	2	0.5	Both animals killed after 52 days—both extensive tuberculosis.
		0.2	2		Both animals killed after 52 days—minimal tuberculosis in all viscera—early productive type lesions.
		2.0	2		Both animals killed after 52 days—both animals negative.
	5 days	0	1	0.5	Killed after 58 days—very extensive tuberculosis.
		0.2	2		Killed after 58 days. Liver and lungs normal. Focal tuberculosis in spleen and inguinal lymph node.
		2.0	2		Killed after 58 days—both animals negative.

Reference

1. Gerber, Isadore E., and Gross, Milton. *Science*, 1945, 101, 616–617.

In the Laboratory

Pulsating Perfusing Apparatus

J. A. Long
University of California, Berkeley

In view of the fact that significant results have been obtained in the perfusing of the pancreas of the rat with whole rat blood, it seems worth while to present a brief account of the apparatus used, which is an improvement over the one described in 1939 (*1*).

This new apparatus is larger than the older one, differs in form and proportions, and has certain entirely new additions, yet embodies most of the former features of construction. It consists of several pieces of thin plate glass, held together by bolts (not shown in the figure), to which are attached all the other parts. The blood "vessels" for the most part lie within the plates and consist of small, drilled holes and half-round channels cut in one plate and covered by another (No's. 1 to 11). Channel 1 connects the reservoir (which also serves as a respiratory chamber) with the pump; 4, 5 and 6 run from the pump to the arterial spout, cannula, and artery of the organ to be perfused; 9 and 10, as veins, carry blood from the venous cannula and spout to the vertical venous return tube, which discharges dark, venous blood over ¼-in. glass balls occupying the upper wide portion of the reservoir which is kept filled with oxygen. The blood, thus trickling down over the balls, becomes bright red and is drawn again into the pump.

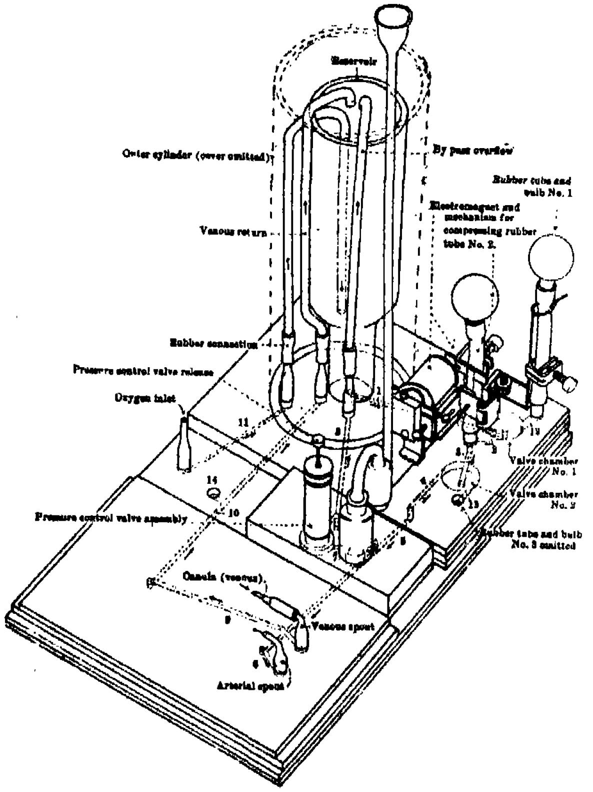

Reservoir
Outer cylinder (cover omitted)
By pass overflow
Rubber tube and bulb No. 1
Electromagnet and mechanism for compressing rubber tube No. 2.
Venous return
Rubber connection
Pressure control valve release
Oxygen inlet
11
1
2
12
3
Valve chamber No. 1
14
4
Valve chamber No. 2
13
Pressure control valve assembly
10
5
Rubber tube and bulb No. 3 omitted
Canula (venous)
9
Venous spout
6
Arterial spout

Fig. 1

The essentials of the pump are: two chambers (large holes bored out of the middle plate of the three of the pump); glass valves (not shown), one sitting over the opening in the bottom of each chamber; connecting channels (2, 3, etc.); and rubber tube and bulb No. 2. The piston is the fluid which moves up and down in the tube as the tube is alternately compressed by the electromagnet and released to expand by its own elasticity. The action of the pump is that of a simple pump forcing blood in the direction of the arrows.

To obtain sufficient pressure the pump must deliver considerably more blood than can pass through the organ. The excess arterial blood is allowed to escape, as it passes along channel 5, through side channel 7, on to 8, and finally through the by-pass overflow to the top of the reservoir. Between 7 and 8 the blood must lift a valve (in the pressure-control valve assembly) which is held down by an adjustable spring. The stronger the spring, the more the pressure is built up in channels 4 to 6. The latter is recorded by the mercury manometer at the end of another side channel off the point of junction of 5 and 7. An automatic release apparatus (not shown) prevents any emergency excess pressure. The pump is capable of delivering pressures up to 200 mm. of mercury.

The form of the reservoir permits the use of small quantities of blood, the minimum being 5 to 10 cc., blood from a rat donor of 450 to 500 grams being sufficient for one experiment.

The specimen chamber is not shown. This varies in shape with the organ under investigation. It is made of plaster of Paris, contains a nichrome heating coil, a thermostat, and thermometer, and will be described in some detail in connection with the results of experiments. The form of the whole apparatus was planned so that the specimen in the chamber can be examined under a microscope.

Reference

1. Long, J. A. *Univ. Calif. Publ. Zool.*, 1939, **43**, 211–216; Plate 25.

An Apparatus for Determining the Respiratory Volume of Large Aquatic Birds

EUGENE DEHNER, O.S.B.
Cornell University

The apparatus shown in Fig. 1 is designed to adapt the oxygen dilution method of clinical lung-volume determination to the measurement of the total respiratory volume of various aquatic birds. In this method, the respiratory gases of the subject are mixed, through a mouthpiece, with a known quantity of oxygen, and the lung volume is calculated by the equation:

(1) Lung Volume (Respiratory Volume) =

$$VO_2 \times \frac{\%N_2 - a}{79.1 - \%N_2}$$

where VO_2 is the volume of oxygen in the apparatus used, *a* is a correction for impurities in this oxygen, 79.1 is the approximate percentage of nitrogen in the respiratory gases, and $\%N_2$ is the percentage of nitrogen found in the mixed gases (*3*).

The spirometer, S (Fig. 1), has a bell adequate to the tidal air of the bird being tested. Two interchangeable bells, with capacities of 90 and 140 cc., and calibrated to equal 1.33 and 2 cc./mm., respectively, on the scale, O, and the record, K, have been used. The technique of Herrald and McMichael (*2*) is employed by keeping constant during a test the volume of the bell, as read on K, through the addition of oxygen at stopcock G. Tidal air and rate of ventilation as well as spirometer volume are recorded on K. The centrifugal fan, F, 5 cm. in diameter, circulates the gases in the apparatus. The water level in the 500-cc. Woulff bottle, W, calibrated to the scale, M, is adjusted with the leveling bottle, L. The chamber, A, contains 16 grams of dry, No. 4 mesh sodium calcium hydrate for absorbing carbon dioxide. The bore of the three-way stopcock, C, is 5 mm. and that of the rubber and glass tubing in the circuit is 8 mm. Negative pressure is exerted through the tubing, V. The temperature of the apparatus is read on the thermometer, T.

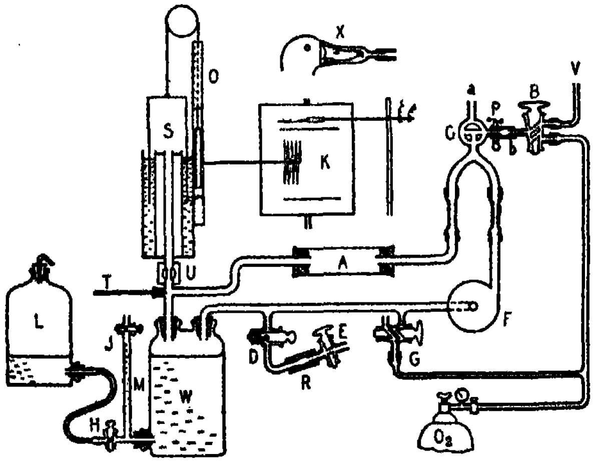


FIG. 1

The apparatus is rinsed and filled with oxygen, as follows: The water level in the bottle, W, is adjusted to zero on the scale, M, and the spirometer bell, usually removed between tests, is replaced in the water seal, while stopcocks C and B are in the position shown. Then, with the fan, F, running, enough oxygen (90–140 cc.) to fill the bell is alternately admitted and withdrawn, about 25 times, by manipulating stopcock B.

The dead space (here 180.0 cc.) may be determined by filling the apparatus with oxygen as above, setting the spirometer bell at zero, and mixing the oxygen with a measured volume of atmospheric air from an aspirator bottle attached at *a* of stopcock C. The mixture is analyzed for percentage of nitrogen, as below, and the dead space calculated by applying equation (1) inversely.

In preparing for a test, sufficient oxygen is added to the dead space to make the total VO_2 of the apparatus equal to the estimated volume of the bird's respiratory system. This is done by opening stopcock B, raising the spirometer bell from zero to the desired point or points on scale O and allowing the measured oxygen to flow into the bottle, W, by opening stopcock H. The bell is set about one-third above zero on scale O, stopcock C is given a half-turn from the position shown, and stopcock B is removed from the coupling, *b*.

A bird is prepared by first tying the tibiotarsal joints and resting the animal on the operator's lap. A glass hood, X, is slipped over the bill and sealed to the bird's head with a rubber flange, prepared from a No. 7 latex balloon. The hood is then attached to the apparatus at *a* on stopcock C, so that the bird breathes air at *b*. The bird is cut into the apparatus at the inspiratory phase, by giving C a quarter-turn counterclockwise. When the fan, F, is started, the spirometer bell falls, and the points on the record rise regularly as oxygen and carbon dioxide are absorbed. Stopcock G is then opened to admit just enough oxygen to restore the points on the record to the original level for the remainder of the test.

A volumetric test, lasting 4 to 8 minutes, is terminated at the inspiratory position by turning stopcock C to the starting position. The bird is now prevented from breathing by the pinchcock, P, which has been clamped on the coupling, *b*, during the mixing process, and while in this condition, samples are quickly drawn from the interclavicular and right abdominal air sacs, through No. 23 Yale needles into 2-cc. glass syringes, oiled and freed of air. Samples of the spirometer mixture are drawn similarly through the rubber tubing at R, after first rinsing some of the mixture through stopcocks D and E while valve U is closed and water flows from the bottle, L, into W. All samples are analyzed immediately for percentage of nitrogen, using Bayer's technique (*1*) with Krogh's pipette.

The respiratory volume (lungs, air sacs, and trachea) of the bird is calculated using equation (1). The figure 79.0 for the normal percentage of nitrogen in the air sacs has been found suitable for this calculation. The final VO_2 of the apparatus is measured accordingly if the points on the record, K, are slightly above or below their starting place.

Corrections for difference in temperature and the vapor pressure of water are added to the calculated respiratory volume. The dead space of the hood, X, is subtracted from the corrected volume. No correction has been made for the error, estimated at less than 2 per cent, due to the diffusion of nitrogen from the blood and tissues of the bird during a test.

Although normally the ventilation of the various air sacs differs greatly, samples taken from the air sacs during a test have been found to check, as a rule, within .5 per cent with those from the spirometer. The apparatus has been used with gulls, and with mallard, black, redhead, and wood ducks. Using mallards and wood ducks, we have tested the duplicability of observations with the apparatus and found the coefficient of variability of test runs made on the same duck, the same day, to be less than 6 per cent and that of runs made on the same duck on different days to be less than 8 per cent.

References

1. Bayer, Fritz. *Gasanalyse; neuere Methoden der Arbeitspraxis unter Berücksichtigung der physiologischen Wirkungen der Gase.* Stuttgart: F. Enke, 1938. Pp. 108–112.
2. Herrald, F. J. C., and McMichael, J. *Proc. roy. Soc. Lond.*, 1939, **126 B**, 491–501.
3. Peters, John P., and Van Slyke, Donald D. *Quantitative clinical chemistry.* (Vol. II.) Baltimore: Williams and Wilkins, 1932. Pp. 217–228.

A New Sterile Technic for Preparing Agar Cup-plates

John E. Christian and Milton L. Neuroth
Purdue University School of Pharmacy

The agar cup-plate method has found considerable application as a test for bacterial inhibitory properties of many substances. Examples of substances which have been tested by this method are liquid products, ointments, dusting powders, catgut, creams, and suppositories (*1*). The test, however, has been greatly limited by the difficulty encountered in preparing, in a sterile manner, suitable uniform cups in the agar. Two standard methods have been used: (1) Before the agar cools, a depression or cup is made in the medium by standing a sterile, flat-bottomed, glass tube in the liquified agar. When the agar is hard, the glass tube is removed by slightly twisting and pulling, and at the same time inserting a sterile wire down the side of the tube for the introduction of air in an attempt to prevent the cracking of the agar. (2) The agar is allowed to harden and then a disk is cut out of the agar by means of a suitably sized sterile cork borer. Both these methods are very cumbersome, and a uniform cup without cracked edges is difficult to obtain. Contamination of the plate is also very common in these procedures, since the lid of the plate must be removed. Still another operation is necessary in these methods—that of placing one or two drops of melted agar in the cup to seal cracks of crevices formed.

A simple new technic is proposed for the preparation of uniform agar cups in a sterile manner. Sterile, flat-bottomed, pyrex glass rods, the diameter of which determines the size of the agar cup, are placed in the liquid agar in the Petri dish, as is shown in Fig. 1. The pyrex glass rods are 10 mm. in length. The agar is allowed to harden, after which each glass rod is heated by means of a small heating element (see Fig. 1). The heating element is slipped over the end of the rod and is held in place by a small glass plunger operated with the forefinger. The agar melts evenly around the rod, which is then easily removed, leaving a uniform agar cup. The small amount of agar which melts adjacent to the rod flows down to the bottom of the cup and solidifies, forming an agar seal at that point. The agar cup-plate is then ready for use.

The heating element is simple in construction and operation. It consists of a 22-gauge chromel resistance wire, wound in a four-turn spiral, the ends of which are sealed with pyrex glass onto the outside of a glass tube with a 6-mm. O.D. and 14 cm. long. The ends of the resistance wire extending beyond the glass seal are attached to an ordinary extension cord held in place on the glass tubing by a tight wrapping of asbestos cord. The temperature of the wire spiral is controlled by plugging the extension cord into any variable resistance transformer; 8 to 10 volts produce a suitable temperature. The plunger consists of a 4-mm. pyrex glass rod which will slip inside the glass tubing. By manipulation with the forefinger the plunger is pressed against the side near the top of the glass rod standing in the agar. At the proper moment the glass rod may be lifted from the agar to form a uniform cup.

Four such cups are made in the agar of each Petri dish. Into one cup is placed a control preparation which contains no active material. Various dilutions of the preparation containing active material are placed in each of the other cups. In the case of liquid preparations 0.10 cc. is run into the cup by means of a sterile syringe or pipette; if an ointment is involved, 0.50 gram is placed in each cup. A pyrex glass tube, graduated and drawn down on one end to a 2-mm. opening, with a glass rod plunger, is used to introduce the solid or semisolid material into the cups. The graduated tube is filled by inserting the small end into the preparation, then carefully applying vacuum on the other end.

FIG. 1

Two methods are available for introduction of the test organism: (1) The base agar may be seeded before pouring into the Petri dish, the glass rods being set and removed as previously described. (2) The method adopted for routine testing of solid materials by the authors has been that of setting and removing the glass rods from sterile base agar. After the preparation has been placed in the cup, a layer of inoculated agar is poured over the base. Twenty cubic centimeters are used as the base layer, and 5 cc. of inoculated agar are poured on top. The inoculated agar consists of 2 cc. of a 16- to 18-hour beef broth culture of *S. aureus* placed in 100 cc. of melted agar.

The layer of inoculated agar, when solidified, seals the preparation in the cup. The Petri dish may then be placed in the incubation oven in an inverted position, thus eliminating any condensation of moisture. The plates are incubated at 37° C. for 16 to 18 hours. Fig. 2 shows the results of a test plate. The zones of inhibition are very uniform for any specific concentration and vary in size according to the degree of dilution. Table 1 indicates the uniform results obtained on a set of plates.

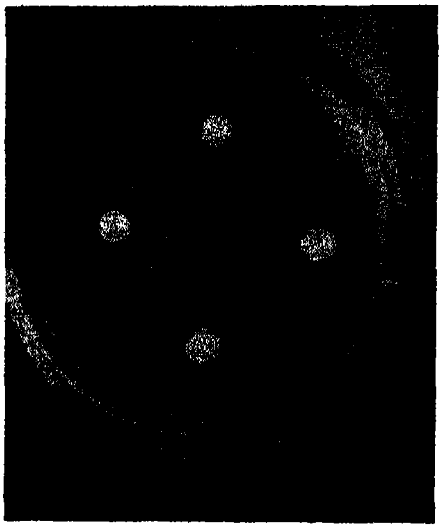


FIG. 2

TABLE 1

ZONES OF INHIBITION IN MILLIMETERS

Plate number	Ointment base	Base containing 1 unit penicillin/gram	Base containing ½ unit penicillin/gram	Base containing ¼ unit penicillin/gram
		mm.	*mm.*	*mm.*
1	no zone	20.50	17.50	13.50
2	"	20.50	17.50	12.50
3	"	20.75	17.50	14.00
4	"	20.75	17.75	13.50

The method described has been used with good success for the routine testing of ointments and creams containing penicillin and has been found to have many advantages over other technics used for this purpose. The heating element for this new technic is inexpensive and easy to manipulate.

Reference

1. ZINSSER, H., and BAYNE-JONES, S. *Textbook of bacteriology.* (8th ed.) New York: D. Appleton-Century, 1939. Pp. 956, 957.

Letters to the Editor

Information for B. and T.

Relative to the letter of B. and T. (*Science*, 1946, 103, 26), the following observation is submitted. Five brothers, all the boys in one family, are all in *Who's Who in America*, 1938–1940. They are Franklin, Henry Clapp, James Morgan, John Harvey, and Welk Alvord Sherman. All were born at Ash Grove, Virginia, and probably attended the same school.

W. O. R.

Department of Agriculture

In the middle 1880's three brothers, William C., E. Henry, and Gustav F. Ruediger attended a one-room country school in School District No. 1, Town of Milton, Buffalo County, Wisconsin. I think you will find these names in the fourth and fifth editions of *American Men of Science.*

E. HENRY RUEDIGER, M. D.

Florida State Hospital
Chattahoochee, Florida

Since the chance of such a coincidence is rather small, B. and T. (*Science*, 1946, 103, 26) wish to know whether any one-room country school other than the one they mention has ever numbered among its alumni two starred scientists. At the end of the 1870's, two brothers, who are both starred in *American Men of Science*, simultaneously attended such a school near Hutchinson, Minnesota. They graduated as classmates from a university in which eventually both served as professors of physics.

Z.

New Haven, Connecticut

In reply to "Information Please" (*Science*, 1946, 103, 26) the following case may be cited: In the later 1870's and early 1880's two boys, born in farmhouses about a half a mile apart and with only two months' difference in their ages, attended, when they became of school age, a one-room country school in Rhode Island. One of them had most of his schooling up to fourteen years of age in that place. When nearly nine years old he was in a graded school for five months, and in another one-room school for seven months, then back to his earlier school. The other boy was in that one-room school during at least two different periods, but for a number of years he attended a graded school in another township. Ultimately, these two went to different colleges, and their careers have been in many respects quite different, but for thirty years or more they have been listed in *Who's Who.* While, therefore, there are many dissimilarities between the early educational advantages of these two men and the ones mentioned in *Science*, the elements of likeness may be sufficient to warrant this note.

One feature that deserves mention is that the teacher in the one-room school during the last three years in which one of these boys attended (and part of that time the other boy was a pupil there) had had a wide experience. He had been a United States consul or vice-consul, in Brazil or Argentina, and had traveled somewhat in Europe. He therefore had a much wider outlook upon life than most teachers in such schools. How much effect this had upon one of the writers, he is not prepared to say. He was out of school entirely from fourteen to twenty-one, but a remark the teacher made when this boy left school at fourteen—"You ought to go on to college"—lingered and may have shaped somewhat his later scholastic career.

T. and W.

Brooklyn, New York

What Can You Do About It?

In *Science*, 1946, 103, 59, Mr. L. J. Thomas suggests that the AAAS take the lead in getting the public more acquainted with the impending dangers of the atomic bomb. The bomb is indeed the most urgent government problem, and an enlightened public is needed. The AAAS should also be able to exert political pressure in this matter. The suggestion that the AAAS take the lead has my full support.

KARL HEYMAN

10 Crestmont Road, Montclair, New Jersey

Announcement

The paper entitled "Physiological comparison of two strains of penicillium," by Robertson Pratt and Jean Dufrenoy, published in *Science*, 1945, 102, 428, contained information obtained under a classified contract between the OSRD and Cutter Laboratories which, in justice to other contractors in the same field, should not have been released. The manuscript of the paper was submitted to the office of the Committee on Medical Research and received official approval for publication. Hence, neither the authors of the paper nor Cutter Laboratories can justly be criticized for this error.

A. N. RICHARDS, *Chairman*
Committee on Medical Research, OSRD

Washington, D. C.

Reversal in the Winter Flounder

Dr. E. W. Gudger's note on reversal in the winter flounder, *Pseudopleuronectes americanus* (*Science*, 1945, 102, 672–673) recalls to mind an additional example of this rare phenomenon.

While shore-seining with Dr. U. B. Stone and Mr. Mark A. Hall in Shinnecock Bay, one mile south of West Tiana, New York, 28 July 1938, we took a single, "left-handed" winter flounder among several hundred normal individuals. My field notes indicate that all specimens were small, and, if I remember correctly, the one left-handed individual was approximately three inches long. The specimen was made a part of the New York State Conservation Department collection and is presumably preserved at the New York State Museum at Albany, New York.

It is of interest to note that of the four recorded instances of reversal in this flounder, two specimens have been taken in Shinnecock Bay.

S. C. Bishop

University of Rochester

The Coloration of Acid Earths Caused by Vitamin A

In some recent issues of *Science* there appeared an interesting discussion concerning the specificity and the history of the intense blue coloration given by vitamin A solutions on acid earths (A. Lowman, *Science*, 1945, 101, 183; H. R. Kreider, 1945, 101, 377; L. Zechmeister and A. Sandoval, 1945, 101, 585; G. G. Mayer and H. Sobotka, 1945, 101, 695; *cf.* P. Meunier, *C. R. Acad. Sci., Paris*, 1942, 215, 470). It was pointed out by Mayer and Sobotka that the observation of this reaction goes back to the year 1939, when it was described by A. Emmerie and C. Engel (*Rec. trav. chim. Pays-Bas*, 1939, 58, 283). Actually these investigators were not the first ones who observed the reaction mentioned. In 1927 K. Kobayashi and K. Yamamoto (*Chem. Zentralbl.*, 1928, 22, 2397; *cf. Mem. Fac. Sci. Eng., Tokyo*, 1927, 4, 23) reported that vitamin A-containing materials, like cod liver oil, give intense bluish or greenish reactions on Japanese clay, Florida earths, or fuller's earth if a benzene or carbon tetrachloride or carbon disulfide solution is applied. They also correctly attributed this reaction to the vitamin A content of the materials investigated.

Henry M. Espoy

Van Camp Laboratories
Terminal Island, California

Preservation of Biological Specimens With Clarite X

A large number of papers have appeared on the preservation of animals by methacrylate resins, but the methods used are difficult and expensive. Very few experiments seem to have been made using other plastics or resins. M. D. Wheatley (*Science*, 1941, 94, 49–50) proposed coating specimens with a solution of isobutyl methacrylate in toluene.

The writer found solutions of *Clarite X* in xylene a satisfactory coating for small animals (spiders, nymphs of Hemiptera, small caterpillars). The specimens were pinned and placed in 95-per cent alcohol, then in absolute alcohol. After a short immersion in xylene they were placed in a solution of 30-per cent *Clarite X* crystals in xylene for about two hours and then left to dry. The resin left a clear coating on the animal. No evidence of excessive shrinkage was observed. The color was preserved better than in the case of specimens kept in alcohol. The specimens were brittle but not much more so than pinned insects. A small addition of paraffin to the resin solution might make the resin less brittle without changing its other properties.

Clarite X, described as a cycloparaffin, may be obtained from the Neville Company, Pittsburgh, Pennsylvania, to which the writer is indebted for supplying samples of the resin for the experiments.

Herbert W. Levi

University of Connecticut

Algae in the Carlsbad Caverns, New Mexico

About two years ago there began to appear in the Carlsbad Caverns, on the pale-grayish limestone wall of the corridor opposite the bottom of the elevator shaft, a slight spotted greenish cast, which in time spread and brightened to a lettuce or grass-green color, not very dissimilar in appearance from the copper carbonate, malachite. It is not copper, however, even though such a supposition is reasonable, for sporadic copper stains are common over a wide area of the Guadalupe Mountains. It is caused by algae, chlorophyl-bearing plants, growing 750 feet below the surface where none have ever been seen before. There are two algae, a green and a blue-green—one an extremely fine aggregate or cluster of bright green cells, the other a pale green, fibrous form. Their habits are such that even their genera can be determined only with difficulty.

The events which have led to the growth of these plants deep down in the cavern are unusual. By December 1931 the elevator shaft was completed through 750 feet of limestone to the floor of the Lunch Room, and elevator service was begun. The corridor leading to the elevator doors was hewn out of solid limestone which was then dry and remained so for more than a decade. Over the elevator doors there was installed an electric light which has been kept burning for about seven hours each day ever since. No change was noticed until sometime in 1943, when a greenish color was first observed to be forming as faint blotches on the rock wall, and this brought to attention the fact that the rock was becoming moist.

To understand this situation better, let us examine certain local events of 1941 which may suggest a cause for the appearance of the algae. In May of that year a torrential rain fell in the Guadalupe Mountains and the surrounding area, which flooded the Pecos River and those of its tributaries heading in the Guadalupe Mountains. On 20 September an even greater deluge fell. Such storms are the result of an enormous accumulation of great, bulbous, cumulo-nimbus clouds which extend from the very ground to altitudes of more than 25,000 feet. To one who has experienced such storms in the field it seems as if the whole column of 25,000 feet of moisture overhead has condensed at the same moment. The Carson Seep Ranger Station reported 17 inches of rain, most of which had fallen in a few hours. During this storm 21.25 inches of rain fell at the headwaters of Dark Canyon, by far the greatest on record in the climatological history of New Mexico.

Though the percentage of run-off on a rocky terrain such as the Guadalupe Mountains is high, these two exceptional rainfalls produced such a notable recharge of ground moisture that in the Fall of 1944 there came a stand of grama grass and other forage in the Pecos Valley the like of which had not been seen for forty years. In some pastures this luxurious display was due also to beneficial results of the Taylor Grazing Act, which has permitted the more sagacious cattlemen properly to husband their ranges.

It is believed that this increment of moisture, overcharging a perched watertable, has found a hitherto unused course through some 500 to 800 feet of rock and, after two years, is seeping out to moisten the rock wall of the corridor. Along with the water may have come the spores of algae; or possibly they were carried in by visitors to the cavern or by down-draft air currents in the elevator shaft. Whatever the mode of their introduction, germination was not possible until both light and water were available. Here in this cavernous void of total darkness no chlorophyl plant life has ever before penetrated so deeply below the surface and survived.

At the Devil's Pool, along the pathway leading down into the cavern from the Auditorium, an electric lamp illuminates for an hour or so each day a large moist stalagmite. A year ago a thin, hard, dark-green coating formed on the stalagmite that is probably the blue-green alga, *Schizothrix*. (In the Fall of 1945 it was noticed that the rock wall at the elevator shaft had grown drier and that the algae are shrinking into clusters. Algae are also to be seen now at the Green Lake and in the King's Palace.)

The only large display of algae growing under natural conditions is that found on the floor of the tunnel leading to the guano cave, 180 feet below the entrance. A cylinder of light, at times partly direct sunlight, projects down onto the rock-strewn floor. Within the circle of light a dull-greyish, black dirt appears to cover the debris. It suggests nothing living and gives rather the impression of being dusty, dead moss. A sample of it sent to Dr. Wm. Randolph Taylor was pronounced a blue-green alga, possibly *Gloeocapsa*, a simple-celled colonial form. This is probably the only place where daylight enters the cavern in sufficient amount to support the growth of a chlorophyl-bearing plant.

(Published by permission of the Director, Geological Survey, U. S. Department of the Interior.)

WALTER B. LANG

Geological Survey
U. S. Department of the Interior

What Is the Matter With *Science?*

How is it that, six months after the first atomic bomb was dropped on Hiroshima—and on the world—neither its editors nor, apparently, any of its contributors, have made any serious and responsible effort to discuss the immense scientific, technical, and social ramifications of this event? Apart from the Truman statement—a document of minor scientific importance—some timely comment by Niels Bohr and Harold Urey, and a letter by Gordon F. Hull, this official journal of American scientists goes along as though nothing particularly out of the ordinary has happened.

A public interest, unprecedented in scope and magnitude, has been generated by the concrete realization of possibilities which a few years ago were shadowy dreams in the minds of men whose very language was an enigma to most of us. In Congress, on the radio, in magazines, books, lectures, and endless discussions, the question of atomic energy has assumed a grim and ruthless primacy, upon whose right solution depend the patterns of human development—conceivably, even, of human survival. Nor can it be said that this urgent public concern is merely another example of mass hysteria that will soon pass, because, this time, it originates in a fundamental scientific discovery that almost overnight has inscribed *mene mene tekel upharsin* upon the walls of our current civilization. Within the past weeks men like Oppenheimer, Szilard, Urey, Langmuir, Smyth, Langsdorf, Shapley, and many others have come out of seclusion and made headlines by their courageous, public-spirited response to the social outcome of their patient researches in nuclear physics. With a heartening unanimity these disciplined and sober minds have recognized the imperative need for thinking in terms of broad human objectives, in sharp opposition to a disgraceful chauvinistic nationalism whose conception of the method and purposes of science belongs on the level of Neanderthal man. Their own organization, the Federation of Atomic Scientists, is active in the promotion of a sane international handling of the myriad problems arising from their work, and quite recently a section of the American Physical Society has gone on record in favor of United Nations control of the atomic bomb.

Yet, so far, *Science* has nothing to say. Why is this? Are the editors themselves indifferent, or do they assume that the question of atomic energy is either too "secret" or too well known to deserve extended discussion? Can they find nothing to publish regarding developments in nuclear physics here and abroad, no statements by foreign scientists that go beyond trifling generalities, no simple and forthright reporting of events in this now-dominant field? Or is it that contributors simply do not care to write anything on the subject for their own magazine—something that will tell other scientists, as well as intelligent laymen, what they are doing and thinking, what the problems are and how they may best be approached with a hope of solution?

Whatever the answer, it seems to me that *Science*, in this matter, is lagging badly in what would appear to be one of its obligations: the prompt, intelligent, and reasonably adequate treatment of what J. D. Bernal has called "the social function of science." I say this without prejudice to the many vital and significant contributions that have appeared in its columns, and with due regard to editorial limitations of space, budget, etc. But I think it needs to be said, and reiterated, now more than ever, when thousands of plain folk are becoming vividly conscious of the enormous power wielded by scientists in our delicately balanced world. I think that the scientists themselves need to know it, to say it, to hear it said, over and over again, for I am convinced, on the basis of the way they have reacted to the present atomic furore, that the great majority are men of good will, striving earnestly that their labors shall end, not in the acceleration of a disastrous social entropy but in the construction of a decent world for all of us.

Harold Ward

129 East 10th Street, New York City

The Prevention of Atomic Warfare

With reference to recent communications from William N. Woodward (*Science*, 1945, 102, 608) and Gordon F. Hull (*Science*, 1945, 102, 672), it is evident that there is a considerable desire for the formulation of plans to prevent the development of atomic weapons. No sane person would question the advisability of doing everything possible to bring this about. However, the methods suggested by these men are open to criticism, and their success is very doubtful. Although it was not mentioned by Mr. Woodward, the apparent *raison d'être* of the Association of Los Alamos Scientists is essentially that of attempting to limit the applications of atomic energy by collective action of the scientists, engineers, and technicians comprising it. They propose also to attempt the forcing of legislation on an international or ''supernational'' scale containing pledges against such military applications. Prof. Hull's plan for a World Association of Physicists is similar, but of his six points, only one is pertinent to the discussion, viz., ''a pledge not to give advice concerning, nor assist in making, atomic bombs.'' Even if 99 per cent of the physicists of the world did so pledge, one could hardly presume that they could thus prevent misapplications of this science. The essential discovery of nuclear fission lies in the borderline field between chemistry and physics, but the deprivation of the project of physicists would not necessarily have prevented the development of a weapon, and in the future this will be much more true. Hence, this solution is as presumptuous as the one which supposes that the men who have had some connection with the manufacture of these weapons in the past have a corner on all the information needed for their production.

What we need, then, is not a Federation of Atomic Scientists, or of Bomb Builders, or even a World Federation of Physicists, but simply a World Federation. Most of the principles suggested as bases for the proposed associations are too obvious to bear elaboration, and the one which the ALAS has used as a smoke screen is virtually one of the purposes of the AAAS, *i.e.* ''. . . to promote attainment and use of scientific and technological advances in the best interests of humanity.''

It is strikingly clear to most of us that this is no time for forcing the hand of the State Department by demanding action on an international scale. This will require mutual respect, trust, and understanding of a high order—virtues which are not displayed by all of the present powers but which must precede any intimate discussion of the most potent force available to man.

James H. Pannell

Los Alamos, New Mexico

Veterans' Retraining Program in Geology

During the past five years it is estimated that the armed forces absorbed some fifteen hundred young American geologists of graduate, near-graduate, or postgraduate status, only a small number of whom had gained any experience in professional application of their learning.

During their terms in the armed services few of these young men have had the opportunity of using their geological training or of acquiring additional geologic knowledge. It may therefore be assumed that they have suffered considerable loss of geologic skill and knowledge and are thus not prepared to resume their studies or professional activities in competition with those geologists whose careers have not been interrupted by the war.

Because of this situation and the current demand for trained geologists, the U. S. Geological Survey proposes to undertake a program of training in the form of supervised field, laboratory, and office work that will enable discharged veterans to adjust themselves more quickly and with more confidence in resuming their careers. The Survey proposes to undertake only this applied phase of the retraining. It recognizes that many of the expected trainees will require preliminary academic courses in college or university geology departments that are equipped to give concentrated courses of graduate calibre.

The proposed dual program has been discussed with heads of the geology departments of the Universities of Chicago, Columbia, Harvard, Johns Hopkins, Princeton, and Yale; and they have indicated their approval of the plan in principle. Heads of geology departments in other schools interested in participating in this phase of the program may obtain pertinent information from the heads of the geology departments of those universities. Further information concerning the Geological Survey's phase of the program may be obtained by writing to W. H. Bradley, Chief Geologist, Geological Survey, Washington 25, D. C.

The instruction of qualified veterans in participating schools will, insofar as is feasible, be adjusted to the specific needs and interests of the individual to better equip him to undertake and benefit by Survey or other professional experience in field, laboratory, and office work during the 1946 field season.

Candidates for these temporary appointments to the Geological Survey will be selected on a competitive basis through the channels of the Civil Service Commission, and in accord with veterans' preference policies. It is hoped, however, that veterans who apply will have had the benefit of the preparatory college or university retraining before they seek appointment.

The number of veterans which the Survey will be able to absorb will depend upon the amount of funds appropriated to the Survey for geologic investigations. An estimate of the size of the field program should be available by spring after the House reports out the appropriation bill. As many as possible of the most competent temporary appointees will be given the opportunity of accepting more permanent appointments on the Geological Survey staff, or will be given aid in obtaining appointments in other governmental agencies or in industry.

This dual program will operate on a very flexible basis, to take care of all individual cases, involving individuals whose academic training and professional experience to date lie within a rather wide range. It will be fitted also to individual desires, to allow for academic training only, for Survey experience only, or for both, depending on the qualifications and wishes of the individual.

W. H. BRADLEY, *Chief Geologist*

Washington, D. C.

Plea for Change in Regular Time of Meeting of the AAAS

Now that the regular meetings of the AAAS are to be resumed, it seems appropriate to consider anew the best time for holding them. There would seem to be three leading possibilities which have been, or are about to be utilized, *i.e.* the traditional Christmas holiday period; the early spring, to be tried this year; and the early fall, shortly following Labor Day, which was tried at Cleveland.

First, as to the traditional Christmas holiday period, the following considerations seem to be pertinent: To reach the meeting at this time it is often necessary to leave home on Christmas night or, at the latest, the day following. This frequently disrupts family gatherings and makes what should be an event to be looked forward to a disagreeable task. It is quite commonly made more disagreeable by extremely inclement weather, late trains, stuffy sleeping cars, and the seasonal presence of the virus of the common cold, not to mention more serious respiratory ailments.

Second, as to the early spring, this may be said: The general conditions at this season, it is true, are no doubt better than those at Christmas, *i.e.* if the time chosen is sufficiently late or "spring" is sufficiently early. Granting, however, that weather conditions are entirely propitious, irregularities in the dates of the spring recesses in the various colleges and universities are bound to make attendance impossible for many, no matter what particular time is set. Incidentally, also, even if the meeting should happen to coincide with one's own recess period, it would consume virtually all of this brief time of respite in the long winter-spring term, a respite often sorely needed to catch up with various odds and ends of work.

Third, in favor of a period shortly following Labor Day the writer would like to urge the following arguments: At this time of year summer vacations for almost everyone have ended, while the fall terms of most institutions on peacetime schedules have not yet started, thus leaving a convenient interim. Also, contrary to the condition at the Christmas season, no holiday celebrations are interrupted, the trains, if one wishes to use them, are reasonably on time, and the weather is such as to make trips by car possible and often pleasurable. It is the writer's belief that all who attended the recent Cleveland meeting held at this time of year will agree that the conditions indicated were fulfilled. Unfortunately, however, wartime exigencies prevented as large an attendance at this meeting as is customary. Why, therefore, not try this time of meeting again under more normal conditions?

It is hoped that this note may stimulate others who favor the view herein expressed to urge favorable consideration of this change upon those concerned in the scheduling of this important event. Indeed it seems as though the matter is of enough significance so that in case of doubt as to the extent of opinion in favor of such a change, a mail ballot of the membership might well be undertaken.

ROBERT S. MCEWEN

Oberlin College, Oberlin, Ohio

The Law of Precharged Luminescence

According to the excitation processes which occur in a light-emitting system, the resulting luminescence may originate in one of several mechanisms: (a) direct excitation, (b) indirect or sensitized excitation, (c) translocated excitation, and (d) precharged excitation (J. De Ment. *Fluorochemistry*. New York: Chemical Publishing Co., 1945). The present communication relates to (d), the precharged luminescence, in which the luminescent system retains the effect of a history of radiation for considerable periods of time (e.g. months or years) and at a later time emits light when subjected to low-temperature heat, friction, and similar agents. The best-known examples of precharged luminescence include the family of thermoluminescences, certain of the triboluminescences, and a number of sundry phenomena.

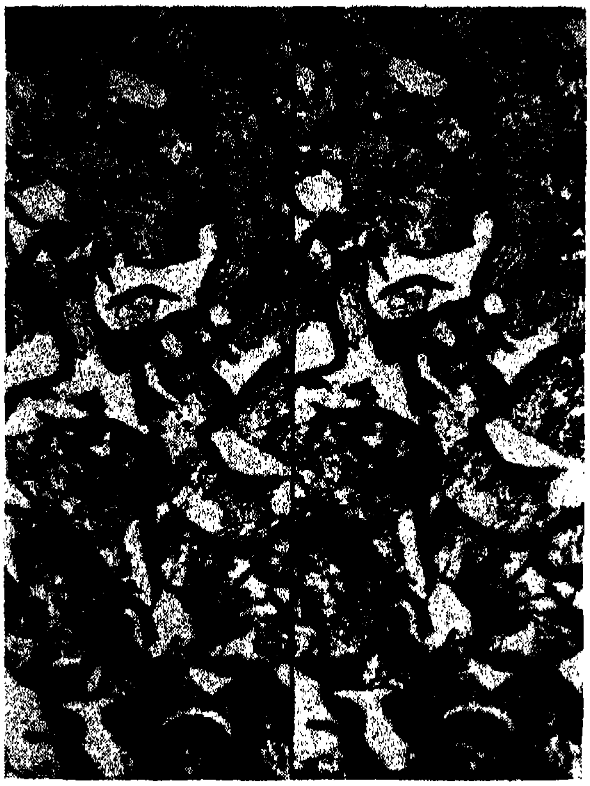
In a recent study and compilation of the known types of luminescence, in which some two hundred varieties were listed, the present writer (*Fluorescent chemicals*, Vol. 3: *Dictionary of luminescent substances*. New York: Chemical Publishing Co., in press) noticed a rather obvious characteristic common to all of the precharged luminescences, to which attention does not seem to have been directed before this time. This common feature can be formulated into a law covering the known types, since no violation has been discovered by the writer in the many examples he has studied. Consequently, the *law of precharged luminescence* is as follows:

"In a system exhibiting precharged luminescence, the energy responsible for the radiation history in that system is always greater than that energy required for the release of the luminescence."

While it is not possible to list here every known case of precharged luminescence to corroborate the foregoing statement, certain well-known examples suffice to clarify what it means. Thus, in the family of thermoluminescences, the agents which provide the radiation history or precharging include radioelement radiations, cathode rays, X-rays, ultraviolet light, visible light, and a number of miscellaneous corpuscular radiations like neutrons. The thermoluminescence takes place when the previously irradiated system is then subjected to such low-energy agents as infrared rays (heat), pressure disturbances (e.g. scratching and grinding), as well as radiations like visible light which are of less energy than that employed for the irradiation.

JACK DE MENT

Fluorescence Laboratories, Portland, Oregon



Comparative Photomicrographs of Cast Iron
Left Field, Taken with uncoated 4mm. 0.95 N.A. Apochromat—Flare 20%
Right Field, Taken with Balcoted 4mm. 0.95 N.A. Apochromat—Flare 4.9%

BAUSCH & LOMB BALCOTED METALLURGICAL OBJECTIVES

Bausch & Lomb now offers the metallurgist the advantage of Balcote surfaced objectives for his metallurgical microscopes. This revolutionizing lens surface treatment applied to metallurgical objectives provides improved image contrast and shorter photographic exposures. "Flare" is decreased; light transmission is increased.

This is of particular advantage where the metallurgist must work with specimens of low reflectivity and long tone range. For complete information write Bausch & Lomb Optical Co., Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

Book Reviews

Heredity and its variability. T. D. Lysenko. (Translated from the Russian by Th. Dobzhansky.) New York: King's Crown Press, Columbia Univ., 1946. Pp. vi + 65. $.50.

For a number of years biologists have been puzzled by the claims of the Russian agronomist, Lysenko, that Mendel's principles of heredity are all wrong and that acquired characters are inherited after all. The original technical papers and books of Lysenko and his followers have been published only in Russian and in general have not been available in the United States or in English translation. In order that Academician Lysenko's work may be judged by biologists who do not read Russian, Prof. Dobzhansky has provided an adequate, literal, and unannotated translation of the 1944 edition of Lysenko's latest book, which was first published in the USSR in 1943. It is thus possible to consult a systematic statement of the author's views in his own words, rather than the indirect accounts contained in translations and criticisms of the debates which he has carried on with Russian geneticists.

Here we find a full, if somewhat repetitive, account of Lysenko's views on reproduction, heredity, inheritance of acquired characters, effects of environment and mutation, in addition to a discussion of some of the problems of plant improvement. It is written from the point of view of a practical agronomist, confines itself almost exclusively to plant material, chiefly the cereals with which Lysenko has worked, and is addressed to a general agricultural audience rather than to a scientific and sophisticated one.

In general, detailed evidence is not given to support the broad generalizations which are made, nor are references given to published experimental data. Instead, brief summaries of results obtained by Lysenko's students and collaborators are presented. Some of these are most remarkable, and it is to be hoped that plant breeders will examine the original data when these become available. For example, a case of vegetative hybridization is reported (pp. 32–35) in which seeds from a branch of a white-fruited tomato grafted on a red-fruited host gave mostly red-fruited offspring, but seeds from these gave in later generations both white- and red-fruited forms.

In later chapters (VII, "Liquidation of the conservatism of the nature of organisms"; and VIII, "The sexual process") equally remarkable results are described in summary form, from which it is concluded that genetically spring varieties of cereals can be permanently converted into winter varieties and vice versa by subjecting the germinating seeds to altered temperatures. From these and other references to altered environment and to constant hybrids, paternal inheritance, maternal inheritance, and parthenogenesis it is concluded that "the heredity of plant organisms may be altered by altered nutrition" and that "it is possible to alter and to create varieties with a desirable heredity by controlling conditions of the external environment, the living conditions of the plant organisms. *The heredity is, as it were, the essence of the conditions of the external environment assimilated by the plant organisms in a series of preceding generations*" (p. 65).

On the whole the book reveals a man whose purpose is different from that not only of geneticists but of scientists generally, since he seeks not so much to understand as to control more directly the processes of nature, and to condemn not merely Mendelism but all theoretical considerations which do not contribute directly to this end. His purpose was to provide new and better methods and improved varieties of plants for the vast expansion of Soviet agriculture which was taking place on the collective farms, and his position and prestige were probably attributable to the promise which his methods seemed to Soviet planners to hold out in this direction, particularly the method of jarovization or vernalization of cereals which is associated with his name.

The author of this book appears as a kind of biological fundamentalist, and the scriptures according to which he interprets his observations were written by Darwin, Lamarck, Spencer, and other nineteenth-century scientists, as these were introduced and popularized in Russia by Timiriazev and Michurin, Lysenko's immediate predecessors and mentors. The primary cause of Lysenko's differences with the geneticists is his adherence to these old views of reproduction and inheritance with which the theories and facts of Mendelian heredity are incompatible. This is clearly brought out in Chapter III, "Individual development of the organism." The author supposes (p. 9) that "the sex cells or buds from which as a rule develop whole organisms are the products of the development of the entire organism which produces these beginnings of new organisms. *They arise from molecules, from granules of various organs* and parts of the organism many times but regularly altered." This is the view tentatively put forward in Spencer's theory of physiological units (1864) and in Darwin's hypothesis of pangenesis (1868) and quickly disproved and abandoned. In supposing that the germ cells derive their properties from the other cells of the organism, this view is the inverse of that generally held for the last 60 years, namely, that the germ cells transmit a stable system of determiners which guide the development of the cells which arise from them.

Needless to say, Lysenko also denies that genes or chromosomes have anything to do with heredity and rejects the most fundamental principle of heredity in the following words:

> "The Mendelians foist this 'pea law,' according to Michurin's happy expression, on the whole of living nature. But in reality it is basically wrong even for pea hybrids, including the factual material obtained by

Mendel himself. The progenies of different hybrid plants varied even in Mendel's experiments much beyond the ratio 3 : 1. Thus, in the offspring of one plant there were 19 yellow and 20 green seeds, and of another plant—only a single green for 30 yellow ones" (p. 55).

Lysenko's ideas on reproduction and development derive, as did those of Darwin and Spencer and Michurin, not from experimentally ascertained facts but from the need for a mechanism by which another supposed fact, the inheritance of acquired characters, may be explained. The need for such a mechanism disappeared with the failure of proof of the inheritance of acquired characters. *No new proofs are given in this book.*

It has been apparent for a long time that Mendelian heredity, as the orderly transmission of relatively stable units (genes) and the inheritance of direct effects of the environment or of training and similar modifications could not both be true. Lysenko clearly believes the evidence for the latter to be more convincing than that for Mendelian heredity. While that view was possible in the Nineteenth Century and to those who ignore the modern facts of heredity, it is strange to encounter so crude a restatement of it in a country where such striking progress in genetics was made as in the USSR between 1920 and 1940. It seems an anachronism somewhat like the denial of the facts of evolution over large areas of a country as progressive as the USA. In both cases the causes of such attitudes seem to those outside the country to be obscure and puzzling. In both cases also the scientific position of the country is so strong that the heterodox views of small minority groups may safely be left to the judgment of time and progress.

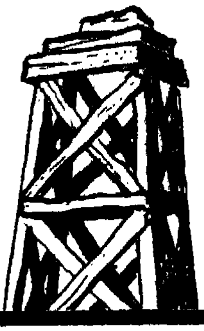
L. C. DUNN

Columbia University

The fortress islands of the Pacific. William Herbert Hobbs. Ann Arbor: J. W. Edwards, 1945. Pp. xiii + 186. $2.50.

This interesting little book is a welcome addition to the meager list of informational volumes on the Pacific. Considering its vast area, the Pacific was surprisingly little known at the beginning of the recent Japanese war. This was particularly true of the territory mandated to Japan. The Carolines, the Marshalls, and the Mariannas were then islands of mystery. Because of extended tours in 1921 and 1923, during which careful notes and maps were made, Professor Hobbs was probably the best-informed person in America on the geologic and geographic aspects of this section of the Pacific at the time of Pearl Harbor.

The book is well illustrated with numerous original maps, diagrams, and pen drawings. The author divides all Pacific Islands into two great groups, the "Arcuate Islands" and the "Strewn Islands." A more detailed classification, based largely on origin, results in the following types: group volcano islands, volcano islands, almost-atolls, atolls, part-raised atolls, raised atolls, newborn arcuate islands, and youthful arcuate islands. Each type forms the subject matter of a separate chapter in which well-chosen examples are used as illustrations. The chapter on the Origin of the Islands is not all which



JUST PUBLISHED

The boisterous saga of America's oil pioneers . . . capturing the restless, enterprising spirit of the great figures of wildcatting — from Williams, Drake, and Galey to Joiner and Gutowsky—and the excitement of life in the oil boom towns. A lively, informal history by a veteran operator and scout.

A selection of the *SCIENTIFIC BOOK CLUB*

THE Wildcatters

By SAMUEL W. TAIT, JR.

Illustrated with photographs.

At your bookstore, $3.00

PRINCETON UNIVERSITY PRESS

might be desired. This is particularly true of the section dealing with the origin of the Strewn islands. The entire Pacific basin is described as an area of shrinking and sinking. Before the sinking began, huge volcanoes were built up at hundreds of points. During the subsequent subsidence the sea eventually occupied the region, and most of the "volcanoes disappeared completely beneath the waves and their positions are indicated today by coral growths built up over them as upon a pedestal—the coral islands or atolls." Although the Darwinian theory of atoll formation lends itself nicely to what is required in a popular book of this type—a simple explanation of atoll formation—still, the facts produced by careful study of the islands demand a much more complex explanation of their origin than is outlined here.

A chapter on the military value of each island type is the unique contribution of the book. A well-chosen bibliography is appended. Professor Hobbs writes clearly and interestingly. Geologists should produce more books of this character instead of leaving it to those less qualified.

J. EDWARD HOFFMEISTER

University of Rochester

The Woods Hole Marine Biological Laboratory. Frank R. Lillie. Chicago: Univ. Chicago Press, 1944. Pp. x + 284. (Illustrated.) $4.00.

Unique in the history of scientific enterprises in the United States is the Woods Hole Marine Biological Laboratory. It is unique in organization, history, and in the scope of its service both to the biological sciences and to the nation. It is national in its services, democratic in organization, and international in its relations. The Naples Biological Station had minimum support from the United States and Great Britain; but in control, staff, and clientele was always essentially German and in recent years has become Italian. It never had the support of France, Russia, or the other European states. The Woods Hole Laboratory, on the other hand, has had the loyal support of many of the leading American universities and colleges, especially of the Atlantic seaboard and Middle West. These were represented in its board of trustees, staff, and clientele. It is fortunate that the history of this institution has been written by one long connected with its operations and while the most of those who have shared in its development are still living.

This book is an important document in the history of the biological sciences on this continent. Its illustrations picture the faces of most of the teachers and investigators of these sciences in the United States during the flowering period of biology in America. Its one great defect is the absence of a suitable likeness of its distinguished author.

The influence of Louis Agassiz and his pupils is evident in the history of the Woods Hole Institution, which is the heir of the short-lived institution at Penikese. Even more dominant in the heredity is the influence of the rapidly growing interest in animal morphology and embryology which stemmed from the laboratories of Leuckart and Balfour and soon burgeoned from the newly established chairs in our universities as natural history gave way to the newer specialties.

One chapter is devoted to the later-established sister institution, the Woods Hole Oceanographic Institution. One function of this marine laboratory has always been its class instruction which brought young biologists under the potent influence of the leaders in the American biological sciences under circumstances which inspire both effort and enthusiasm. The effect of this function upon the expansion and quality of American teaching and research is imponderable but potent.

CHARLES A. KOFOID

University of California, Berkeley

Scientific Book Register

BEST, CHARLES HERBERT, and TAYLOR, NORMAN BURKE. *The physiological basis of medical practice: a University of Toronto text in applied physiology.* (4th ed.). Baltimore: Williams and Wilkins, 1945. Pp. xiii + 1169. (Illustrated.) $10.00.

COLLINGWOOD, R. G. *The idea of nature.* New York: Oxford, 1945. Pp. 192. $4.00.

FITCH, LYLE, and TAYLOR, HORACE. (Eds.) *Planning for jobs: proposals submitted in the Pabst postwar employment awards.* Philadelphia: Blakiston, 1946. Pp. xxii + 463. $3.75.

FULTON, JOHN F. (Ed.) *Howell's textbook of physiology.* (15th ed.) Philadelphia: W. B. Saunders, 1946. Pp. xxxv + 1304. (Illustrated.) $8.00.

LUSH, JAY L. *Animal breeding plans.* (3rd ed.) Ames, Iowa: Collegiate Press, 1945. Pp. viii + 443. (Illustrated.) $3.00.

MACGREGOR, GORDON. *Warriors without weapons: a study of the society and personality development of the Pine Ridge Sioux.* Chicago: Univ. Chicago Press, 1946. Pp. 228. (Illustrated.) $3.75.

MASSERMAN, JULES H. *Principles of dynamic psychiatry: including an integrative approach to abnormal and clinical psychology.* Philadelphia: W. B. Saunders, 1946. Pp. xix + 322. (Illustrated.) $4.00.

MERRITT, ARTHUR H. *Peridontal diseases, and soft tissue lesions of the oral cavity.* (3rd ed.) New York: Macmillan, 1945. Pp. 276. (Illustrated.) $3.50.

POSNANSKY, ARTHUR. *Tihuanacu: the cradle of American man.* New York: J. J. Augustin, 1945. Vol. I: Pp. viii + 158; Vol. II: Pp. viii + 246. (Illustrated.) $30.00.

RICHTER, KENNETH M. *A work-text on human embryology.* St. Louis: John S. Swift, 1945. Pp. 178. (Illustrated.) $3.75.

TURNER, RUFUS P. *Radio test instruments.* Chicago-New York: Ziff-Davis, 1945. Pp. xiii + 219. (Illustrated.) $4.50.

SCIENCE

Vol. 103, No. 2668 Friday, February 15, 1946

The Butter-Margarine Controversy[1]

Harry J. Deuel, Jr.

School of Medicine, University of Southern California

THE QUESTION WHICH VITALLY INTERESTS all of us is whether we need to feel undue alarm from a health standpoint at the present-day scarcity in butter. In other words, need we be necessarily distressed not only for our adult population but especially for our growing children if the butter shortage continues over a prolonged period?

We have become much more conscious as to what good nutrition involves since the war began. The Food and Nutrition Board of the National Research Council has published a chart of recommended dietary allowances which have been generally accepted as the most authoritative information to date. In their table, they have separated the requirements not only according to age and sex but also according to the extent of activity. In addition, this committee has suggested certain minimal dietary requirements necessary during pregnancy and also during the period of lactation. In the opinion of the Board, there was already adequate experimental evidence to indicate the probable daily requirement of calories, protein, and such inorganic ions as calcium, iron, copper, and iodine. It was also possible to formulate recommendations for the daily quantities of the fat-soluble vitamins, A and D, needed, as well as for two members of the B complex, namely, thiamin (B_1) and riboflavin (B_2 or G). Figures for the amount of vitamin C required were also included. While it was recognized that other inorganic salts and a number of vitamins listed as members of the B complex are also essential in an adequate diet, it was considered that our present information is inadequate to hazard a guess as to the amount required. While it is generally recognized by students of nutrition that, at best, the quantities of nutrients postulated by the Food and Nutrition Board of the National Research Council are tentative, this table has served as a most useful yardstick in the formulation of diets of high quality.

The question of importance in the topic under discussion is whether the fats play a specific role *per se* in this nutritional picture; if they do, one must ascertain whether such a function is reserved for butter and animal fats or whether it is shared generally by the vegetable fats and oils as well. The vegetable oils and fats (including the hydrogenated ones) are practically identical in physical and chemical properties with the animal ones. Can the body cells reject one and require the other?

Fats are the best vehicles for dissolving the fat-soluble vitamins, A, D, E, and K. From that standpoint, one might regard the fats as an essential foodstuff since they afford a simple medium to assure the absorption of these required vitamins.

Fat is also the most concentrated form of energy. To obtain the energy to produce the 2,500 calories which the person of average stature expends daily, it is necessary to oxidize ingested foods or, in their absence, body tissue. As large a proportion as 85 to 90 per cent of this total energy may originate from the metabolism of either carbohydrate or fat (or, as is generally the case, of a mixture of these foodstuffs). The quantity of fat to supply all the necessary heat would be 240 grams, since fat has an energy value of 9.3 calories per gram; were carbohydrate to serve as the sole source of this 90 per cent of the daily caloric requirement, about 550 grams would be used, as this foodstuff has a heat value of only 4.1 calories per gram. Moreover, since carbohydrate is usually present in foods along with considerable quantities of water while the fatty foods may be largely free from water, the discrepancies between the weight of food required to satisfy the caloric needs of the animal far exceed the 2.3 to 1 ratio of the caloric values of fat to carbohydrate.

It is believed that certain types of fats which are normally components of such structural parts as cell membranes cannot be manufactured in the animal body. The only source for this material, which appears to be an unsaturated fat, trilinolein, is in the food. Fats must be considered essential to the extent that they are necessary to furnish an adequate amount of this constituent. Corn oil is especially rich in trilinolein while butter may be largely devoid of it. We, of course, manufacture the usual type of adipose tissue without the necessity of the fat being supplied in the diet. An excess of fatty tissue is generally a reflection of a fondness for carbohydrates, since we can readily transform the latter foodstuff into fat.

---

[1] A lecture given before the Men's Faculty Club of the University of Southern California on 28 May 1945.

An examination of the dietary habits of animals gives us definite evidence that milk fat is not required after infancy. Wild animals have continued a normal existence over centuries without milk or butterfat after weaning. Except for the cat, dog, and pig, the same is also true for domestic animals. As far as the human is concerned, the widespread use of butter and milk in the diet of the adult, made possible by the domestication of the cow, goat, horse, or camel, has come late in the history of the human race. Man has attained his physical and mental stature largely without milk fat after weaning. In fact, within our present era, certain Indian tribes have been known to live satisfactorily after the nursing period on diets which are completely devoid of milk or butterfat.

We come back now to the question as to how effectively oleomargarine can do the job of butter. The term "oleomargarine" dates back to the time when oleostearine and oleo oil, by-products of the meat packing industry, were its principal ingredient. But still legally any margarine, regardless of the nature of the fat it contains, must be labeled "oleomargarine."

In the beginning, the margarines were maligned as inferior fats which were indigestible. However, investigators in the Office of Home Economics of the U. S. Department of Agriculture for some time previous to and during World War I had been comparing on human subjects the digestibility of various well-known animal and vegetable fats as well as many which were so unusual from a commercial standpoint that they were curiosities. With a very few exceptions, the coefficient of digestibility was invariably found to be approximately 95. This means simply that 95 of every 100 grams are absorbed from the gastrointestinal tract during the course of digestion and are therefore utilizable. In this group were all the common cooking oils as cottonseed, corn, peanut, and olive oils as well as butter and lard. The only exceptions to this relatively complete digestibility were noted with beef and mutton tallow and deer fat as well as several other natural or artificial fats having a melting point considerably higher than body temperature. Studies on several different oleomargarines by these same government scientists demonstrated equally high digestibilities for the oleomargarines as for butter. It is an interesting commentary that although these experiments were completed in 1917, the publication of the results was not made in one of the series of scientific government bulletins where the reports of the tests on the other fats had been published but in the *Boston Medical and Surgical Journal* in 1925 after the principal author had severed his connection with the government bureau. Today, no one questions the high digestibility of margarine.

Another earlier objection, political rather than nutritional, brought up against margarine was that it was made from foreign fats which were brought in to compete with the products of American farms. This may have been partially true when coconut oil was the basic fat used in margarine production; certainly, it can no longer be raised as an objection now that cottonseed, peanut, and soybean oils or animal fats which are almost entirely domestic products are practically exclusively used for the present-day margarine manufacture.

A third argument for the superiority of butter over margarine was advanced in 1913, when it was found that the former was a good source of vitamin A. Since it was soon determined that this vitamin, so essential for growth and for life, was absent in most vegetable oils, there would then appear to be some justification for the preference of butter to margarine on nutritional grounds. However, as soon as colorless vitamin A concentrates were available (there was a law against use of yellow-colored oils even when they contained the same natural provitamin A as butter, *i.e.* β-carotene), it became the practice to add sufficient of the vitamin A concentrate to margarine so that the concentration of vitamin A would be equal to that of an average butter. The amount of vitamin A to be used for the enrichment of margarine was originally set at 7,500 U.S.P. units per pound but later raised to 9,000 U.S.P. per pound, which was considered the average quantity in butter, although different butters may vary from 2,500 to 20,000 units per pound. Unfortunately, there is no way for the housewife by inspection of its label or of the butter itself to ascertain how much vitamin A is present. Although high concentrations of vitamin A usually run parallel to increasing yellow color in the natural product, this is not always the case. In fact, butter samples having the highest concentrations of vitamin A ever reported, produced by feeding massive doses of this vitamin to the cow, were found by the author to be practically colorless. But even if the depth of color were invariably a satisfactory index of the richness of butter in vitamin A, this criterion would be valueless as far as market butter is concerned. Artificial colors, which have no nutritive value whatsoever, are usually added to bring the product to the desired hue. Butter is the only food exempt from the requirement of the pure food laws which makes mandatory the declaration of artificial color on the label of foods. No statement is required on the label or elsewhere that an artificial color has been added.

However, several years ago reports were published in the *Journal of Dairy Science* of work carried on in the University of Wisconsin indicating that butter *per se* possesses a certain growth-promoting influence (independent of the vitamin A effect) which could not be demonstrated in various vegetable oils. Weanling rats when given diets of whole milk grew faster during the first three weeks than other rats which received skimmed milk into which vegetable fats were homogenized. The differences were largely eliminated by the end of the six-week period. It was suggested that this effect of butter was to be ascribed to certain long chain saturated fatty acids present in the butterfat which were not contained in the vegetable oils. This was taken as the long-awaited "proof" that butter possesses some inherent characteristic not shared by vegetable fats which make its use in animal nutrition preferable. Although these preliminary experiments were not convincing from a scientific standpoint, the results were heralded far and wide by the dairy interests. It was not long before many of our intelligent citizens were wondering if butter should not be a "must" in the diet.

Extensive experiments were undertaken several years ago under the direction of the author at the University of Southern California to amplify the studies started at the Madison laboratories. These experiments were planned to avoid several criticisms of the earlier work which obviously would favor the butter animals. In the first place, the weanling rats were so distributed into the groups receiving the various diets that the average weights were identical in the various groups at the start. In the Wisconsin tests, the rats which were given the butter diet weighed 31 per cent more at the start of the experiment than those which were fed the cottonseed and soybean diets. Since the weight at weaning is a good index of the subsequent rate of growth, such low-weight groups could hardly have been expected to have grown as well even if afforded a superior diet to the butter rats. A second difficulty of the Wisconsin group was avoided by using dried skimmed milk powder mixed with the various fats instead of the liquid skimmed milk. In this way the diet remained homogeneous and a separation of fat from the liquid milk did not occur. The results of our tests showed that corn, cottonseed, olive, peanut, and soybean oils as well as a commercial margarine were all equally efficacious in promoting growth, as was butterfat on diets of mineralized skimmed milk powder which were fortified with the fat-soluble vitamins. No differences in rate of growth were noted after 3, 6, and 12 weeks. That the growth was similar for the rats on the different diets was further confirmed by the finding that the growth of their bones (tibia) at 3 and 6 weeks measured by X-ray photographs was identical. The diets were all shown to be equally well utilized, as demonstrated by the fact that the same amounts were required to cause equivalent growth. Moreover, the composition of the body tissues of rats sacrificed after receiving the different diets for 12 weeks was also shown to be similar. This would indicate that all fats were equally efficient in producing real growth and that the gain in weight in no case was only the result of an undue deposition of fat.

The Southern California experiments reported above also demonstrated the important part flavor may play in the diet. It was found that when rats were given a choice, they would usually prefer the butter-containing diet to the one having the vegetable oil. It was found that this preference is related to the so-called "butter flavor" normally present in butter, and it can as readily be induced by pure diacetyl or by commercial butter flavor as by butter itself. The quantities necessary to induce this preference are very small, only 4 parts per million being required. In fact, rats prefer a level of 4 to 8 parts per million and 8 to 16 parts per million. Possibly some of the better growth reported earlier on rats receiving butter may be because the animals are induced to eat more of such food. The flavor is a pleasing one which they have learned to prefer during the period of nursing. As far as can be determined, however, diacetyl plays no essential role in nutrition, and it can be manufactured by the normal male as well as by the lactating female.

In further experiments it was reported that the vegetable oils were equally satisfactory components of the diet as butter in furnishing adequate nutrition for normal pregnancy and for lactation. The index as to the efficiency of lactation can be deduced from the proportion of baby rats which survive as well as by the weight of the rats when they are weaned at the age of 21 days. In a large number of tests on the various vegetable fats, margarine, and butter, there was no evidence of superiority in any dietary group. In fact, in all cases the diets were equally effective in allowing normal pregnancy and successful lactation.

Recently some additional evidence has been adduced on the claim of the Wisconsin investigators that butterfat is especially required by the very young rats. They stated that prematurely weaned rats required butterfat to a greater extent than animals weaned at the normal time. Moreover, if animals were weaned at a later than normal period, no superiority in the butter diet could be noted. However, Zialciti and Mitchell, of the University of Illinois, were able to raise successfully rats fed on artificial mixtures by the use of medicine droppers starting within seven days after birth. When such animals were given mixtures containing corn oil, the subsequent growth was as satisfactory as for those which were fed on a mixture containing butter as the fat. We have reported similar results on a large series of rats weaned at 14 days instead of the usual 21-day period which received diets containing a butter or margarine or corn, cottonseed, peanut, or soybean oils.

More recently, the Wisconsin scientists have stated that growth of young rats was as satisfactory when oleomargarines were incorporated in the diets as when butter was the fat, provided that the basal carbohydrate in the diet was starch, dextrin, sucrose, glucose, or mixtures of them. Only when lactose was the sole carbohydrate was there some indication of less satisfactory growth on the nonbutter tests. It should be mentioned that the lactose content in these tests was higher than in whole milk powder. When lactose is present in the proportion found in whole milk, the weight of evidence is that all vegetable fats have a nutritive value similar to butter if fortified with the fat-soluble vitamins.

Another crucial test for the adequacy of a diet is its ability to support growth and reproduction over a number of generations. Dr. H. C. Sherman, of Columbia University, has maintained a colony of rats for 50 generations on a diet consisting of one-third whole milk powder, two-thirds whole ground wheat, and a little salt supplemented with small amounts of lettuce and lean meat once a week. Such a diet must therefore be considered as entirely adequate for the rat. In the May 1945 issue of the *Journal of Nutrition,* there is a progress report of the author detailing experiments where rats had already been maintained over ten generations on a diet identical with Sherman's except that skimmed milk powder was used in place of the whole milk powder and an amount of margarine fat was added corresponding to the normal content of butterfat in the whole milk powder. These tenth-generation animals were in much better physical condition than the first-generation rats. In fact, at the present time the experiment has progressed to the thirteenth generation and the rats have continued to be in excellent condition.

It is a moot question how far tests on rats can be applied to humans. Certainly many of the dietary deficiency diseases found in the human subject have their counterpart in the rat. The rat, like the human, is omnivorous. The anatomy of the gastrointestinal tract is similar. To accomplish a study over ten generations in the human would require 300 years compared with five years in the rat. From the analogies between rat and man, it is not too much to expect that a diet which is nutritionally satisfactory for the rat would also be beneficial for man and vice versa. Conclusions on the nutritional value of diets for humans based on rat experiments would seem to be entirely justified as far as fats are concerned.

Even had it been shown that milk fat were a requirement for animals or for man, one would expect that the milk fat from any one species of animal would meet the requirements best for that particular species. It is well known that there is a wide difference in the composition of the milk of different species and also that this variability in composition also obtains with the fat. Hilditch and Meara in the conclusion of a paper where the composition of fat from human and cow's milk has been compared state the following:

> Human milk fat, in regard to its component acids, has more resemblance to a typical margarine fat-blend than to butterfat.

The experiments that I have just outlined reaffirm that fact that vitamin-fortified margarine and butter have a substantially equivalent nutritional value. They are supported by the conclusions of an entirely unprejudiced group, the Committee on Public Health Relations of the New York Academy of Medicine, who recommend in their report of 1 February 1943 as follows:

> In order that the health of the population may not be impaired by the adoption of a diet insufficient in fats and fat soluble vitamins, the Committee recommends that the manufacture, distribution, and consumption of oleomargarine be encouraged and suggest specifically:
>
> (1) That the regulations set by the Federal Security Administrator in 1941 be amended to make it mandatory that all oleomargarines be fortified with vitamin A at a uniform level of 9,000 United States Pharmacopoeia Units per pound of finished product;
>
> (2) That the War Production Board be requested to allow the use of fats and oils for the manufacture of oleomargarine in such quantities as would offset the necessary withdrawal of butter from civilian use;
>
> (3) That federal and state laws which restrict the manufacture and distribution of oleomargarine be suspended for the duration of the butter crisis;
>
> (4) That wide publicity, both lay and professional, be given the fact that oleomargarine, fortified by vitamin A, is nutritionally equal to butter; and
>
> (5) That this matter be brought to the attention of the President of the United States, the Secretary of Agriculture of the United States and his Technical Assistant on Civilian Requirements, and the Commissioner of Agriculture and Markets of New York State.

Moreover, a similar conclusion has been reached by the Food and Nutrition Board of the National Research Council in their Reprint and Circular Series, No. 118, released in August 1943, where it is stated:

> (1) Margarine fortified with vitamin A in accordance with Food and Drug regulations supplies an important amount of this nutrient as well as of much needed fat. A previous recommendation of the Food and Nutrition Board that all margarine be fortified is reaffirmed. Because of the high proportion of margarine now fortified, mandatory requirement of fortification for all margarine for table use seems unnecessary at present, though it may become desirable if the situation changes in such a manner as to reduce importantly the proportion now fortified.
>
> (2) The present available scientific evidence indicates that when fortified margarine is used in place of butter as a source of fat in a mixed diet, no nutritional differences can be observed. Although important differences can be demonstrated between different fats in special experimental diets, these differences are unimportant when a customary mixed diet is used. The above statement can only be made in respect to fortified margarine and it should be emphasized that all margarine should be fortified.
>
> (3) It is obvious that the present excise and license taxes imposed by both Federal and State governments on margarine interfere with the distribution and utilization of certain of our fat resources, but the implications of these taxes are so extensive and complex that no recommendation with respect to them can be made in this report.

Finally, it should be stated that the nutritional value of milk is not confined to the fat; it possesses proteins of excellent quality and it is an excellent source of certain inorganic salts needed in the diet, such as calcium and phosphorus. Milk is an especially adequate source of riboflavin. We can scarcely view with concern the increasing use of margarine in the diet if that means that larger amounts of whole milk become available at a reasonable cost for human consumption.

Developing Food Acceptance Research[1]

W. Franklin Dove, *Chief*

Food Acceptance Research Branch, Subsistence Research and Development Laboratory, Quartermaster Depot, Chicago

At the present time there appears to be in process of development a science which treats of foods and the consumer of foods as a *relationship* in which the producer or processor of foods (for industrial survival) and the consumer of foods (for human survival) share an equal interest.

During World War II, now just ended, each item of the ration had been carefully produced and prepared according to quality specifications, and each item had been tested to contain and retain through long periods of storage its quota of vitamins, minerals, protein, and calories. But when the soldier-consumer refused to accept some of these ration items, and when these items began to accumulate in the storage dumps in various theaters of the war, a new problem in supply, theretofore unrecognized, was raised to a major issue. To determine the causes of nonacceptance followed as an official directive.

Parallel with the refusals by the soldier-consumer, populations under economic stress, or belabored with a poor soil, or lost in the forest fringe or in marginal environments, or seduced into overspecialization, reveal similar conflicts over acceptance and nonacceptance of foods.

The reasons for this parallel will appear with further development of the subject. Needless to say, both the Army population under stress and the civilian population isolated from the normal balance of supplies—even though it may be living in the midst of a prosperous society—have much in common.

But why had not the subject of food acceptance become an issue before? In order to answer this question and in order to uncover causes, as a step toward instituting prevention, let us go back a few decades.

Not long ago, even in the time of our grandfathers, there was little need for concern over the nonacceptability of the harvest. Each family was largely self-sufficient. Out of the family garden the *seed* for the coming year—and only the best—was selected. That *best* of the harvest was judged at the family table by means of a sizable panel of children and parents, aunts and grandparents, a panel representing all ages and both sexes.

Locally adaptable varieties of sweet corn, apples, squash, peas, beans, bred on the spot for acceptability, were also prepared and cooked in home style. Home cooking meant recipes devised out of the ingredients at hand, upon which the family panel had also placed its stamp of approval. These home recipes had sometimes passed through the judgment of generations of families: As the seeds from the best-flavored or the finest-textured foods were saved, so too were the favored methods of preparation and cooking passed down from mother to daughter or from mother to daughter-in-law.

---

[1] Research in food acceptance was formally introduced into the Army's food supply program when, in November 1944, a Food Acceptance Research Branch was set up in the Subsistence Research and Development Laboratory, under Col. Rohland A. Isker, Commanding Officer. Food acceptance research has since been included as a section of the food research program of the Military Planning Division, OQMG.

This paper was presented at the Conference on Food Acceptance Research held on 6–7 December 1945 in Chicago, under the sponsorship of the Committee on Food Research, Military Planning Division, OQMG.

Accordingly, then, the family taste panel passed judgments three times daily, from a breakfast *for work* to a supper *after work,* every day of the week from Monday's labors to Sunday's rest and throughout the seasons, from rain to heat to snow. Though subject to the influences of *imitation,* as when a child imitates one of his parents in food choice; of *domination,* as when a parent punishes a child by depriving him of dessert; of *urging,* as when a mother who, in concern for the well-being of the sickly child, urges him to drink milk; or of *resistance,* as a form of a child's self-assertion in refusing any or all foods presented, nevertheless, the vocal judgments of the family taste panel varied from unanimous vote against the food to unanimous acclaim for the food. The family taste panel passed judgment upon many characteristics conceded important in today's scientific panels: (1) odor, appearance, flavor, texture, and temperature; (2) frequency, monotony, or amount served; (3) the variety grown and even, indirectly, the nature and fertility of the garden soil; (4) methods and temperature of storage as these conditions affected keeping quality; and (5) keeping quality of the raw food, or as cooked (processed) and sealed within the jug, barrel, or jar. All of these judgments, combined into a family chorus, came to expression in the food habits of the consumers and came finally to shape the pattern of the agriculture of every region.

During these earlier times in our history, there were segments of the population isolated from the soil and consequently subjected to limited diets; but for none of these did concern over taste, flavor, and acceptability rise to the level of social, economic, or scientific importance until recent times.

We may conjecture that this gradual rise to awareness of the problem of food acceptability is the result of the gradual change, taking place during the past century, toward *commercial* agriculture with *quantity production* as the chief goal, together with the widespread production by the great food industries of processed and canned foods for the market, while the original strings of taste authority of the family, as producer and processor and consumer, were severed one by one.

By slow but certain strokes the family's seed stock was replaced by the nursery seed stock, by the stock of the large commercial seed house, by the stock of the State and Federal government experimental seed plots —seed stocks which were developed for resistance to diseases and for high yields. By the same slowly changing pattern of life the family's home-canned foods have been displaced by the standardized, colorfully-labeled, commercial product. The advantages to these changes are greater than appear on the surface.

While the civilian consumer's food-getting habits have changed, so too have the methods of feeding armies. Mechanized warfare of World War II required combat and assault rations which possessed operational characteristics for ease of handling, compactness, and keeping qualities, together with nutritional adequacy and acceptability. Such requirements increased the need for *quantity* production and for *commercially* processed, dehydrated, cooked and canned foods in order to keep up with the rapid surge of huge armies. Such armies, as in the Normandy campaign, must travel fast; or, as in the Pacific Island theater, they may be separated for weeks, or even months, from the normal supplies of fresh perishable foods. For the first time in history large groups of men lived for long periods of time solely on commercially produced and processed foods.

Limited and imposed diets, consumed often under stress, tested severely the nutritional adequacy of rations and, even more, their acceptability. For no matter how adequate these foods and rations were nutritionally, only in so far as they were accepted were they a dependable conveyor of nutriment to the body.

With acceptability of foods in this salient position, and with our continued interest in mass feeding, the need has arisen for a careful screening of all scientific researches and methods which might contribute to the evaluation of foods for acceptability. Neither the food producer nor the food processor nor the food consumer (soldier or civilian) can afford to allow food acceptability to remain in its past-present unorganized form. All indications lead one to believe that postwar developments in foods and in feeding, as well as in other approaches to the biological aspects of man's adjustment to his environment, will make extensive use of the scientific advances that may be made in these directions.

The science of genetics has taken the guesswork out of seed selection for disease resistance; food technology and experimental cookery have taken the guesswork out of food processing and food preparation; the science of nutrition has taken the guesswork out of the "plus" factors in foods; while physiology has devised accurate measures of physical and nutritional status of the consumer. But by this modern, efficient, centralized production and processing of foods on the one hand, and by the recognition and supply of the major and minor nutrients required for abundant health on the other, we have left out the relationship—we have left out the *connecting link* between the living subject (the consumer) and the stuff of life (food) he lives upon: *that link is acceptability.*

Now is the time for the *essence* of the family taste panel, now lost, to be returned—not as it was, but in a modern scientific form, to follow the food from its seed, through development and processing, to the finished, or even assimilated, product. Such a science, if properly developed, is destined to contribute to both consumer and producer alike.

Who will develop the science of food acceptance? Since food acceptance, as someone has aptly remarked, is an in-between study, its proper development will depend upon the combined interest of numerous special approaches. It should include:

(1) Those who have attempted to grade foods for *quality* for government or army specifications, since an application of the blind panel of judges selected on proven ability to test the food or item according to a reliable statistical design provides unbiased decisions and scientific quality control;

(2) Those interested in psychometrics in order to standardize the quality-control methods used for liquors, tea, and coffee, and apply them to milk, eggs, beverages, and finally to all classes and kinds of foods;

(3) Those in food technology and home economics who have used organoleptic methods to determine chemical or physical changes in foods treated or stored in numerous ways;

(4) The biological sciences concerned with self-regulation, or with the embryology, anatomy, or physiology of the sensitivities related to food-getting and to appetite and hunger;

(5) Those interested in social psychology and anthropology, to indicate the background of forces in which food-getting has been reared.

There is need for economists who are aware of the physiological demand as well as market demand; nutritionists who consider food *selection* from the psychological standpoint; and psychologists who know that *food* selection is a matter of nutritional importance.

The question will also continue to tantalize the chemist, who will always try—and may some day succeed—in detecting differences and tracing dilutions with an accuracy equal to that of all the gustatory sensitivities.

Finally, it should interest those who are administrators of research, since food acceptance techniques provide *direction* from the consumer. In other words, food acceptance tests are on more than a mere service-level, since in addition to this they may be used not only *to develop* a product from a correct combination of parts, but also to indicate *what foods to develop* and *in what direction.* As such, they serve the administrator and should therefore be free of any compartmentalization which would disturb their functional nature.

In order, then, to develop the subject of food acceptance as a unit of research, we of the Food Acceptance Research Branch of the Subsistence Laboratory have included in the physical plant the facilities for as many of these approaches as seemed feasible and have relied on various research laboratories of the country, both university and industrial, to carry on correlated research where the best talent, ability, and equipment exist.

Thus, the Food Acceptance Research Laboratory includes in actual concrete structure the facilities for a large number of the potential functions of such research: the statistics of sampling, of design, and of results; the physiology of sensitivities and the psychology of attitudes; the physicochemical tests of quality of the foods; experimental cookery as related to preference; psychometrics and organoleptics. Each of the divisions of interest may be likened to a part of a car: Organoleptics or psychometrics may be the wheels, consumer likes and dislikes (physiological psychology or anthropology), the car body; while experimental cookery may be likened to the snubbers and upholstery. No single part can assume the prerogative of the whole.

During the last six months 215 tests for acceptability have been run on 708 items of foods. The foods tested include every food class, from soup to meats, potatoes, cereals, fruits, beverages, vegetables, desserts, confections, and nuts. Entire rations have also been tested. All of the items intended for rations are now tested for acceptability *before* they enter the rations. The same techniques are used to determine by taste test panels the best methods, from the standpoint of acceptability, for packaging and storing, and the optimum keeping time or shelf-life.

New research methods have had to be devised for nearly every food class or type of food. Each food presented for test presents a special problem which must be analyzed through careful discussion with commodity specialists and with others interested in the development of the food.

The results of the tests are presented as memoranda for administrative action, for further development, or for use by the procurement officers to serve as one of their guides in purchasing supplies. The purchase of the winter's supply of breakfast cereal, for instance, may be influenced by the panel judgments as to brand, composition, method of toasting, etc.

The results of these tests are also being prepared for publication as research papers, since methodology is at present at the crux of testing: Without reliable methods the tester and his results are at the mercy of personal opinion. Several points which characterize these new methods include the following:

(1) A panel of judges is selected for ability to detect the differences expected to arise.

(2) The test is blind, without comparison of notes by the judges.

(3) A record of differences is secured, together with word records to express the differences.

(4) A record is kept of both positive and negative attitudes toward the differences.

(5) There is a statistical design in the experiment set up in order to measure all variables separately and together and establish significance of results.

When the tests are carried out according to these and other precautions, the results may then be considered reliable. Further tests in camps or in the field must be made to evaluate the relative preference for these foods by the group as a whole. The results show, however, that many totally unacceptable foods can now be eliminated before they enter the ration; that many foods are preferred only by *part* of the population and must therefore be accompanied by substitutes; that some items are so well liked and, fortunately, so stable in the storage method indicated that procurement can proceed with confidence. For example, the best variety of peas as tested by the blind panel turned out to be the variety requested most on the grocery store shelf. Such results indicate actual use-value of the methods.

As we have previously indicated, however, our laboratory approach is not sufficient in itself. Preference for, or prejudice against, a food is a population problem. Attitudes toward foods relate particularly to food habits built up over the years from birth to maturity. Furthermore, food habits are related to the soil, the climate, the food crops, and the socioeconomic and even religious characteristics of each region. The final effect of food habits upon the civilian and soldier-consumer from each region should be measurable in terms of physical stamina and success in adjustment in times of stress.

The acceptance rates of foods is a part of the general topic of food habits which has been studied in this laboratory. The Committee on Food Composition of the National Research Council has compiled tables on the nutritive value of American foods. The nutritionist, however, needs additional information in order to devise rations or to evaluate foods correctly. The nutritional value of each food is measured not alone by its nutrient content per 100 grams, but rather by the nutrients in the total amount of each food accepted and, of that, the amount assimilated and utilized. The issue is direct; the arithmetic simple. *Each food must be evaluated not by what it possesses but by what it gives to the consumer*; and it gives to the consumer in gross value its per cent value per unit weight times the weight of food accepted. Acceptance rate in turn depends upon a chain of events and influences, any one of which may negate the chemically high nutrient quality of any food. Thus, acceptance rate waits upon the degree of preference, depends upon form and method of preparation, is hindered or facilitated by differences in flavor of the different genetic varieties, and is influenced by its physiological effect upon, and assimilation by, the individual. In the end, food habits, through acceptance rates, mold the physical status of the consumer, soldier and civilian.

Edgar T. Wherry points out in this issue of Science (page 206) that there really cannot be a Soviet science because science is wholly without national identification. It is interesting to note that every nationality does have its own concept of its importance in the development of science and technology. The following extract is taken from *VOKS Bulletin*, a publication of USSR Society for Cultural Relations with Foreign Countries:

> For two centuries Russian scholars, inventors, engineers, and talented, self-taught scientists created the bases for modern electrification. Their work, which was of world-wide importance, is one of the greatest prides of our people.
>
> As far back as 1752 lightning rods were invented by M. V. Lomonosov, the father of Russian science.
>
> The searchlight is the child of Russia twice over: the light of its voltaic arc was the discovery of V. V. Petrov, the first Russian electrical engineer (1802), while the construction and focussing of its optics was the work of the electrical engineer V. N. Chikolev (1890).
>
> The first electric mine was invented during the Crimean War by B. S. Jacoby, member of the Russian Academy of Sciences (1854).
>
> The electric lamp is fruit of the work of A. N. Lodygin (1874).
>
> The explosion-proof electric lamp was invented by the Russian electrical engineer V. N. Chikolev (1880).
>
> The transformer was the invention of I. F. Usagin (1882).
>
> The generator was improved by P. N. Yablochkov, A. I. Poleshko and others; the electric motor was invented by M. O. Dolivo-Dobrovolsky (1890). The electric welding instrument was the invention of N. G. Slavyanov (1885).
>
> The radio and radio broadcasting are the inspired invention of the Russian scientists and electrical engineers A. S. Popov (1895) and M. A. Bonch-Bruevich (1920).

Association Affairs

James Bryant Conant

Karl T. Compton, *President*
Massachusetts Institute of Technology

WHEN JAMES BRYANT CONANT accepted the presidency of Harvard University in 1933, at the age of forty, he made the decision to forego the further satisfactions of his brilliantly productive career as Sheldon Emery professor of organic chemistry and chairman of the Department of Chemistry and to shoulder the more complex responsibilities as educational leader of this, the oldest and greatest of our nation's universities. How great and complex these responsibilities were to be he could not then have foreseen, for the next dozen years brought World War II and found him by sheer force of merit and ability in the top key positions of scientific leadership in this struggle. Now, with victory but a few months past, he leads his institution out of its great war program into a well-studied new program of education, and he becomes president of the American Association for the Advancement of Science.

In his own work as a chemist, Dr. Conant has made many contributions of permanent value in two important fields: structural studies of complex natural products, and investigations of basic theoretical significance in the borderland joining organic and physical chemistry. In the latter class is his work on the dissociation of organic molecules into free radicals and quantitative rate and equilibrium studies on organic reactions, including replacements, dissociation of acids, and enolization. Studies of the properties of hemoglobin and the structure of chlorophyll were his major contributions in one of the most complex portions of the field of natural products. An example of Dr. Conant's dual interests in research and teaching is the fact that at the peak of his productivity as an investigator he found time to write the book which has become the most widely used text of organic chemistry.

In recognition of Dr. Conant's achievements in chemistry he was awarded the Chandler and Nichols medals in 1932, the medal of the American Institute of Chemists in 1934, and the Priestley medal of the American Chemical Society in 1944.

Dr. Conant's initial war service was as a Lieutenant in the Sanitary Corps of the U. S. Army in 1917, and in the following year he became a Major in the Chemical Warfare Service. He was one of that small group of outstanding young American chemists who so quickly developed American competence in the production and use of poison gas, and protection against it, *immediately after this frightful new weapon had* been launched by the Germans against the allied forces in France.

Because of this experience and his subsequent eminent career as a chemist, it was therefore natural that he should have been appointed by President Roosevelt as the chemical member of the National Defense Research Committee when this agency was established as a national defense measure in June 1940 under the chairmanship of Dr. Vannevar Bush. When the President, in 1941, expanded this scientific preparedness program by the establishment of the Office of Scientific Research and Development under the directorship of Dr. Bush, it was equally natural that Dr. Conant should become the chairman of NDRC and thus take the major responsibility for the organization of the nation's civilian scientific effort in the development of new weapons. To this work he brought not only his knowledge of science and acquaintance with scientists, but also great skill in administration and an unusual ability to avoid confusion and entanglement in minor complexities, and to cut through quickly and decisively to the fundamental issues involved.

Then, in the following year, there was another call to service when our supplies of natural rubber were cut off by the Japanese invasion of the East Indies, and the nation was faced with a near impasse of conflicting councils for averting the complete paralysis which would result from rubber bankruptcy. In the Summer of 1942 the President appointed Dr. Conant as the chemistry member of the Baruch Rubber Survey Committee which, after a hectic two months study, submitted to the President the recommendations followed so successfully in establishing a great program of synthetic rubber production and conservation of our remaining natural rubber resources.

Then, in 1943, came the most difficult and important assignment of all as member of the small committee which was appointed to steer the atomic bomb project from the preliminary stage, in which the first laboratory demonstration was made of the feasibility of a nuclear chain reaction, to the final climax on 6 August 1945, when the first atomic bomb was dropped on

Hiroshima. During these last two years of the war Dr. Conant spent an increasingly major portion of his time on the atomic bomb project, unbeknown to any except a few of his closest colleagues, but in spite of this added burden continued effectively to coordinate and steer the program of NDRC.

Any one of the above war assignments would have been a notable contribution to the nation. Taken all together they constitute a truly remarkable record of achievement, and one which can be fully appreciated only by those who have themselves known at first hand something of the magnitude and complexity of the problems which were involved, as well as the success of the achievements and the importance of their contributions to the winning of the war.

Some of these responsibilities continue but, happily, on a much-diminished scale, and Dr. Conant is now able to devote increasing time to the reconversion problems and to the establishment of the revised educational program at Harvard University, based on the report of the Harvard committee on General Education in a Free Society.

This record of achievement is ample explanation of Dr. Conant's election to the presidency of the American Association for the Advancement of Science. With the confidence and the teamwork which were developed among American scientists during the war, there is a very great opportunity for the advancement of science and its effective contributions to our society in the era of peace which we now enter.

Science Legislation

Compromise Bill for a National Science Foundation

Howard A. Meyerhoff

Executive Secretary, AAAS, Washington, D.C.

Agreement has been reached on the final draft of a National Science Foundation bill which will make its way to the Senate floor as rapidly as legislative machinery can function.

Senator Saltonstall presided at the meeting 9 February, held in the Military Affairs committee room at the Capitol, which accomplished a resolution of conflicting views and redrafted a National Science Foundation bill. Senators Kilgore and Magnuson, representatives of the Committee Supporting the Bush Report, the Committee for a National Science Foundation, and the American Association for the Advancement of Science, with legal counsel, discussed the few remaining provisions of S. 1720 still in dispute. Complete accord was effected on every issue under Senator Saltonstall's leadership.

The new bill,[1] which will now go to the Senate, will be known as the Kilgore-Magnuson Bill. Senators Johnson, Pepper, Fulbright and Saltonstall, and possibly others, will be co-sponsors. The new draft will bear a new number, although S. 1720, introduced 19 December 1945, served as its base (*Science*, 1946, **103**, 39–44).

The changes are not many in number and some of them can scarcely be called improvements; but they have served the purpose of providing safeguards liberalizing, qualifying, or clarifying clauses in S. 1720 to which objections had been raised. The relationships between the Administrator and the National Science Board have been more precisely delineated, reducing the possibility of friction and deadlock. The functions of the Division of Social Sciences are yet partially restricted until the divisional committee surveys the field and submits its recommendations to the Board. Somewhat more rigid standards are placed upon all projects for which Foundation support is sought, and the Adminstrator is given more latitude in denying subvention to proposals that do not conform to the policies and standards of the Foundation.

The patent provisions of S. 1720 have undergone extensive revision without sacrificing the basic principles of free dissemination and public use of all knowledge and discoveries arising from Federal support. The attempt has been made to provide equal access to Foundation support or contracts without requiring or inviting changes in corporate structure of the applicant bodies. At the same time government agencies are no more restricted than they have been in arranging to have essential research done. The new bill provides for the absorption of the Office of Scientific Research and Development and of the Roster of Scientific and Specialized Personnel. The new bill provides a new horizon for international cooperation.

It is a document which combines sound scientific thinking with sagacious political realism and to which scientists can unhesitatingly lend their support.

---

[1] *Science* will carry the full text of the new bill 22 February.

Technical Papers

The Ratio of Carotene to Carotenoid Pigments in Sweet-potato Varieties

Boyce D. Ezell and Marguerite S. Wilcox[1]
U. S. Department of Agriculture, Beltsville, Maryland

The sweet potato has long been recognized as a valuable source of carbohydrates in the human diet. More recently its importance as a source of carotene (provitamin A) has been stressed. Sweet potatoes vary greatly in depth of yellow or salmon color, not only between varieties but also within a variety. Depth of color within a variety has been used as a criterion of excellence in the selection of improved strains of some of the standard varieties. If the yellow color of the sweet potato is due to carotene alone, it is readily evident that varieties with deep-colored flesh are much more valuable as a source of provitamin A than are those with lightly-colored flesh. If other carotenoids are also present, then the relative amounts of carotene and other pigments are a matter of interest. This study was made to determine what portion of the yellow pigment in different sweet-potato varieties is carotene.

Matlack (*5*) studied the yellow pigments of the Porto Rico variety. After phasic separation of the extracted pigments, attempts to isolate crystalline xanthophylls from the alcoholic phase proved unsuccessful, but other tests indicated the presence of violaxanthin. Chromatographic adsorption of the recrystallized pigments of the epiphase on a Tswett column of calcium hydroxide gave four colored bands, only the lower band yielding sufficient material for isolation of crystals. He identified these crystals as β-carotene. From these results he concluded that the latter was the predominant pigment of the sweet potato, with a small amount of xanthophylls, one of which was violaxanthin. He gave no data, however, as to what percentage of the total yellow pigments was β-carotene. Lease (*4*) states that the yellow pigment of Porto Rico sweet potatoes is almost entirely β-carotene, and Villere, *et al.* (*6*) working with the same variety, also state that it is the principal carotenoid pigment of sweet potatoes. Other workers have reported carotene as the principal yellow pigment of sweet potatoes. However, little if any quantitative data have been reported as to the relative amounts of various yellow pigments in different varieties of sweet potatoes.

In the work reported here each sample analyzed consisted of 20 grams of a composite of half of each of three to six unpeeled potatoes split lengthwise, ground in a food chopper, and mixed thoroughly before sampling. The Wall and Kelley method (*7*) was used in extracting the pigments and determining the carotene. The aqueous-alcohol fraction contained little, if any, pigments. The ether extract was a clear yellow. The total ether-soluble pigments was determined photoelectrically from the petroleum ether extract before chromatographing, and the carotene after chromatographing. Both were read at a wave length of 460 mμ, and the concentrations calculated from the same concentration curve, prepared from 90 per cent β- and 10 per cent α-carotene.

The mean concentrations of total pigments, carotene, and the carotene/total-yellow-pigment ratio for several varieties of sweet potatoes are given in Table 1. It is readily evident that yellow pigments other than carotene are present in these sweet-potato varieties. A limited number of analyses made on several intervarietal hybrid selections being grown at the Plant Industry Station at Beltsville, Maryland, showed that they too contained other yellow pigments. The ratio of carotene to total yellow pigments varies with different varieties, and the greater the concentration of total pigments, the higher the carotene/total-pigment ratio. In general, this relationship holds true not only within a variety but also within individual roots, as shown in Table 2, in which are presented results for individual roots and portions of roots ana-

TABLE 1

The Carotene and Total Pigments of Different Varieties of Sweet Potatoes

Variety	No. of samples	Total pigments mg./100 grams* Means $\pm s_{\bar{x}}$	Carotene mg./100 grams* Means $\pm s_{\bar{x}}$	Ratio $\frac{\text{carotene}}{\text{Total pigments}} \times 100$ Means $\pm s_{\bar{x}}$
Maryland Golden ..	42	5.84 ± .086	5.18 ± .083	88.64 ± .46
Porto Rico	48	4.37 ± .066	3.58 ± .068	81.76 ± .70
Nancy Hall	38	1.81 ± .036	1.09 ± .038	60.01 ± 1.40
Vineland Bush ...	49	0.73 ± .018	0.24 ± .010	32.04 ± .84
Southern Queen ..	41	0.47 ± .066	0.13 ± .004	28.29 ± .45
Triumph ..	19	0.40 ± .006	•	•

* Fresh weight basis.

• Approximately one-fourth of the pigments at harvest was carotene, but the carotene fraction had disappeared by early December. Samples taken from storage in late May contained a small amount of carotene.

---

[1] Biochemist and assistant mycologist, respectively, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration.

lyzed separately. These results show the wide variations that may occur within the Porto Rico variety and emphasize the need for care in the selection of propagating stock. No relationship between weight, length, or circumference of the root and the total pigments, carotene, or the carotene/total-pigment ratios was evident in this variety.

TABLE 2

THE CAROTENE AND TOTAL PIGMENTS OF INDIVIDUAL ROOTS OF PORTO RICO SWEET POTATOES

	Total pigments mg./100 grams	Carotene mg./100 grams	Ratio $\frac{\text{carotene}}{\text{Total pigments}} \times 100$
Individual roots	6.95	6.39	91.94
	6.32	5.52	87.34
	5.88	5.05	85.88
	5.66	4.75	83.92
	5.48	4.60	83.94
	4.94	4.13	83.60
	4.81	3.90	81.08
	4.77	3.99	83.64
	4.64	3.90	84.05
	4.47	3.85	86.13
	4.32	3.76	87.04
	4.32	3.65	84.49
	4.21	3.43	81.47
	4.17	3.49	83.69
	4.13	3.51	84.98
	4.13	3.34	80.87
	4.03	3.41	84.61
	3.97	3.26	82.11
	3.92	3.31	84.44
	3.91	3.13	80.05
	3.72	3.11	83.60
	3.70	3.03	81.89
	3.64	2.89	79.39
	3.25	2.56	78.77
	2.82	2.25	79.79
	2.78	2.01	72.30
	2.10	1.46	69.52
Portions of same root			
stem end	6.75	6.08	90.07
center	4.46	3.87	86.77
root end	3.44	2.36	68.60
stem end	5.54	4.59	82.85
center	3.98	3.38	84.92
root end	2.76	2.08	75.36
stem end	5.43	4.72	86.92
center	3.82	3.28	85.86
root end	2.97	2.30	77.44
stem end	3.15	2.39	75.87
center	2.26	1.66	73.45
root end	1.43	.76	53.15

The position of the other pigments on the chromatogram and the tenacity with which they were held indicate that they are different from those known to have provitamin A activity. Neo-β-carotene B or any other carotene of known provitamin A value would probably be carried down in the carotene fraction as here prepared.

Discussion. Kemmerer and Fraps (*2*) have reported that carotene prepared by the usual methods, including that reported here, may contain several fractions, some of which may have no biological activity. Their method calls for adsorption on a column of calcium hydroxide. While suitable for the separation of the various carotene isomers, it is not adapted to rapid routine analysis because of the time-consuming elutions involved.

Kemmerer, Fraps, and Meinke (*3*) have recently reported that the "crude-carotene" of raw sweet potatoes (variety not named) contained, besides β-carotene, neo-β-carotene B and "impurity A." They also found 2 per cent of neo-β-carotene U in one of the five baked samples tested and up to 27 per cent (average, 5 per cent) of this isomer in dehydrated sweet potatoes. No α-carotene was found in any of the samples. "Impurity A" has little if any biological value. Neo-β-carotene B has one-half that of β-carotene, and neo-β-carotene U was reported by Kemmerer and Fraps (*2*) as of no biological value, but Deuel, *et al.* (*1*) reported it as having 38 per cent of the value of β-carotene. According to Kemmerer, Fraps, and Meinke (*3*) the total biological activity of the "crude carotene" in the three samples of raw sweet potatoes tested was equivalent to 88 per cent β-carotene, and in the baked and in the dehydrated samples it was 76 per cent. Whether these figures are representative of all varieties is not known. Kemmerer and Fraps (*2*) reported earlier that both carotenoid X (neo-β-carotene U) and α-carotene were present in fresh sweet potatoes (variety not named) to the extent of 5.4 and 1.4 per cent, respectively, but in a later paper (*3*) reported neither to be present.

Summary. The fleshy roots of the sweet potato are shown to contain appreciable amounts of yellow pigments other than β-carotene. The carotene/total-pigment ratio varies among different varieties and within varieties. In the varieties tested, the carotene/total-pigment ratio increased with increase in intensity of yellow color. Triumph, a very light-colored variety, contained a small amount of carotene shortly after harvest, but this soon disappeared in storage.

References

1. DEUEL, H. J., JR., JOHNSTON, C., SUMNER, E., POLGAR, A., and ZECHMEISTER, L. *Arch. Biochem.*, 1944, 5, 107.
2. KEMMERER, A. R., and FRAPS, G. S. *Ind. eng. Chem.* (Anal. ed.), 1943, 15, 714.
3. KEMMERER, A. R., FRAPS, G. S., and MEINKE, W. W. *Food Res.*, 1945, 10, 66.
4. LEASE, E. J. *Proc. Ass. S. Agric. Workers* (42nd Annual Convention, Atlanta), 1941. P. 162.
5. MATLACK, M. B. *J. Wash. Acad. Sci.*, 1937, 27, 493.
6. VILLERE, J. J., HEINZELMAN, D. C., POMANSKI, J., and WAKEHAM, H. R. R. *Food Ind.*, 1944, 16, 76.
7. WALL, M. E., and KELLEY, E. G. *Ind. eng. Chem.* (Anal. ed.), 1943, 15, 18.

Amino Acid and Protein Deficiencies as Causes of Corneal Vascularization: A Preliminary Report[1]

V. P. SYDENSTRICKER, W. KNOWLTON HALL, CHARLES W. HOOK, and EDGAR R. PUND

University of Georgia School of Medicine, Augusta

The appearance of vessels in the cornea of rats deficient in tryptophane and lysine was first described

---

[1] This investigation was aided by grants from the John and Mary R. Markle Foundation and Merck and Company.

by Totter and Day (*9*). Albanese and Buschke (*2*) have since observed corneal vessels in the eyes of tryptophane-deficient rats, and recently Albanese (*1*) showed that these vessels were not affected by the administration of riboflavin. We (*5*) have confirmed and extended the observations of Totter and Day with regard to the corneal vascularization which appears in lysine deficiency. This also was neither prevented nor affected by large amounts of riboflavin.

A considerable variety of conditions result in corneal vascularization. In addition to those causes mentioned above, corneal vascularization may result from riboflavin deficiency, vitamin A deficiency, zinc deficiency, thallium poisoning (*3*), or tyrosine poisoning (*6*). Our observations as well as the observations of others indicate that the appearance of corneal vessels is not a universal finding in all deficiencies, though there seem to be causes of corneal vascularization other than those listed above. Machella and McDonald (*8*) report a series of patients who showed the accepted clinical picture of riboflavin deficiency including corneal vascularization, but none of whom showed any marked improvement on treatment with riboflavin. Lyle, Macrae, and Gardiner (*7*) determined the degree of corneal vascularization in about 4,000 RAF personnel at 10 stations in England and 12 stations overseas. Of the vascularization observed, some was apparently due to riboflavin deficiency and responded to treatment with this factor. However, their experiments suggested that other factors present in fruits and vegetables influenced the vascularization more than riboflavin. No definite evidence of improvement was found following treatment with the other pure vitamins tried, but the most definite benefit was obtained where the diet was supplemented by a good variety of nutritious foodstuffs. They thought that the degree of corneal vascularization in their groups of subjects was a reliable index of the general state of nutrition of the group, although it seemed that the corneal vascularization of some of the subjects was due to causes other than nutritional deficiency since there was no response to a superior diet.

Recently we have investigated the effect of methionine deficiency in the production of corneal vascularization. Of 44 rats from 8 litters of Wistar rats placed on methionine-deficient diets[2] at weaning or shortly after, 8 developed corneal vessels seen with the biomicroscope. This observation was confirmed by examination of histological sections of the eyes of some of the rats. The rats were fed daily from amber glass stock bottles of the diet which were kept in the cold. The average daily riboflavin intake of the four rats on the methionine-deficient diet calculated from food consumption was 70 µg. per rat. Since 30 µg. of riboflavin per week protects rats against riboflavin-deficiency cataracts (*4*), this would appear to be an ample riboflavin intake.

Since corneal vessels seem to result in rats on lysine-, tryptophane-, and methionine-deficient diets, it occurred to us that the development of corneal vessels might be a general effect resulting from a deficiency of protein or amino acids. Accordingly, we placed a litter of four Wistar rats on a protein-free diet[3] when they were 30 days of age. Although some eye changes such as a moderate degree of corneal opacity resulted, no vessels were observed with the biomicroscope. The animals died in an average of 31 days after they were placed on the diet. We have found that with severe nutritional deficiencies the animals may die before the corneal vessels appear, even though the vessels do appear when the deficiency is less severe, so a litter of three Wistar rats 41 days of age was next placed on the same diet. Definite invasion of the cornea by vessels was observed with the biomicroscope between the fourteenth and sixteenth days on the diet in two out of three rats. When the two rats died after 36 days on the diet, vascularization and other corneal changes were well advanced. The third rat at no time showed any corneal vessels.

Since that time 15 Wistar rats from seven litters have been placed on the same protein-free diet and 11 control rats from the same seven litters were fed with a diet containing protein.[4] These rats varied in age from 50 to 62 days at the time they were placed on the diets. In from 9 to 20 days, all the rats showed definite invasion of the cornea by vessels on biomicroscopic examination, and none of the control rats over a period of six weeks have shown more than normal variation on biomicroscopic examination of their eyes. These findings have been confirmed by histological section of the eyes of some of the rats. The riboflavin intake of the rats on the protein-deficient diet as calculated from the feed records averaged 98 µg. per rat per day.

As Buschke (*3*) has pointed out, the rat seems particularly susceptible to vascularization of the cornea, and as a consequence, the question of the applicability of studies of this sort to human nutrition is a matter of interest. In this connection one of us[5] has made the following observations: In May 1945, a biomicroscopic examination was made of some 200-odd inhabitants of Leyden, The Netherlands, who were selected at random from the population. Ten per cent were suffering from famine edema. None of the individuals examined showed corneal vessels.

---

[2] The composition of the methionine-deficient diets was: cottonseed oil, 80 grams; cod-liver oil, 20 grams; salt mixture, 40 grams; choline, 2 grams; calcium pantothenate, 20 mg.; thiamin chloride, 4 mg.; pyridoxin, 4 mg.; riboflavin, 10 mg. The diets contained 90, 100, or 110 grams of vitamin-free casein and sufficient sucrose to make a kilo. The salt mixture is as used by J. M. McKibben, *et al. Amer. J. Physiol.*, 1939, [illegible], 102.

[3] Same as methionine-deficient diet except that sucrose was added in place of casein.

[4] Same as methionine-deficient diet except that it contained 240 grams of the casein.

[5] V. P. Sydenstricker.

From this, it would appear that while deficiencies of any of three different indispensable amino acids or of protein may result in corneal vascularization in the rat, further investigation is necessary before the significance of these findings with reference to human nutrition becomes clear.

References

1. Albanese, A. A. *Science*, 1945, **101**, 619.
2. Albanese, A. A., and Buschke, W. *Science*, 1942, **95**, 584.
3. Buschke, W. *Arch. Ophthal.*, 1943, **30**, 735.
4. Day, P. L., Darby, W. J., and Langston, W. C. *J. Nutrition*, 1937, **13**, 389.
5. Hock, C. W., Hall, W. K., Pund, E. R., and Sydenstricker, V. P. *Fed. Proc.*, 1945, **4**, 155.
6. Huefer, W. C., and Martin, G. J. *Arch. Path.*, 1943, **35**, 685.
7. Lyle, T. K., Macrae, T. F., and Gardiner, P. A. *Lancet*, 1944, **1**, 393.
8. Machella, T. E., and McDonald, P. R. *Amer. J. med. Sci.*, 1943, **205**, 214.
9. Totter, J. R., and Day, P. L. *J. Nutrition*, 1942, **24**, 159.

Dehydroascorbic Acid in Cabbage

Thelma J. McMillan and E. Neige Todhunter

Laboratory of Human Nutrition, University of Alabama

In analyzing school lunches for ascorbic acid content using the method of Roe and Oesterling (*3*), dehydroascorbic acid was found to be present in appreciable amounts. The average content for 55 plate lunches was 14.8 mg. of reduced ascorbic acid and 5.9 mg. of dehydroascorbic, giving a total of 20.7 mg. (*2*). Thus, there was 40 per cent more ascorbic acid present than would have been accounted for by the usual indophenol procedure.

These findings prompted us to question whether the reported losses of ascorbic acid in cabbage, when prepared as salad and allowed to stand, could be accounted for, at least partially, as dehydroascorbic acid. The destructive effect of metallic catalysts and time of chopping have been noted by several investigators, but in few studies has the reversibly oxidized form of the vitamin been reported. The method of Roe and Oesterling is sensitive to small amounts of ascorbic acid and is not open to some of the criticisms of the hydrogen sulphide method.

Values for fresh cabbage were obtained from a wedge cut from the intact head and immediately immersed in acid and then ground in a Waring blendor. The remainder of the head was cut within five minutes, either with a knife or a hand shredder, and samples taken for analyses at regular intervals. Reduced ascorbic acid was determined by the method of Loeffler and Ponting (*1*) and dehydroascorbic acid and total ascorbic acid by the diphenylhydrazine procedure of Roe and Oesterling (*3*).

Typical results are given in Table 1. When the cabbage was chopped with a knife there was a 13.5-per cent loss of reduced ascorbic acid after standing 120 minutes. However, the values for dehydroascorbic acid indicated that this was not a true loss but that a large portion was changed to the reversibly oxidized form. The total ascorbic acid at the end of 120 minutes was 5.8 per cent less than at the beginning; thus, there was a small destruction of the vitamin during this holding period. Shredding with a hand grater caused a total destruction of 4.7 per cent of the vitamin; with this method of preparation there was an increase in the amount converted to dehydroascorbic acid.

TABLE 1

ASCORBIC ACID CONTENT OF CABBAGE AFTER CUTTING AND SHREDDING (MG./100 GRAMS)

Flat Dutch Cabbage	Knife			Shredder		
	Reduced	Dehydro	Total	Reduced	Dehydro	Total
Before cutting	47.3	4.8	50.1	47.6	6.1	53.1
Immediately after cutting	41.5	10.4	49.4	35.5	15.1	52.2
15 minutes after cutting	40.6	10.8	46.3	35.7	17.1	52.5
30 minutes after cutting	40.4	9.1	46.1	34.9	15.7	51.5
60 minutes after cutting	41.1	8.8	49.2	35.3	15.6	52.5
120 minutes after cutting	40.9	8.5	47.2	36.3	14.8	50.6

The average values for all heads of cabbage are shown in Table 2. There was a 5-per cent loss of total ascorbic acid when shredded and held for 120 minutes. The maximum loss occurred in the first 15 minutes and did not increase on standing.

TABLE 2

PER CENT OF THE TOTAL ORIGINAL ASCORBIC ACID PRESENT AS REDUCED, DEHYDRO- AND TOTAL ASCORBIC ACID

Treatment	Knife cut (4 heads)			Shredded (5 heads)		
	Reduced	Dehydro	Total	Reduced	Dehydro	Total
Before cutting	99.9	8.4	100.0	92.9	10.3	100.0
After cutting	86.0	10.9	96.8	67.7	30.7	97.0
15 minutes after cutting	86.8	20.0	97.2	66.1	32.5	95.2
30 minutes after cutting	87.7	19.4	93.8	65.5	29.9	90.1
60 minutes after cutting	87.5	17.9	97.2	66.2	29.2	95.2
120 minutes after cutting	89.3	16.6	98.4	67.6	26.8	95.1

When cabbage was cooked by boiling for 12 minutes and then held on the steam table for two hours, there was marked destruction of the vitamin. Only 25 per cent of the total ascorbic acid present in the freshly cooked cabbage was retained, and 50 per cent of the total amount present was in the form of dehydroascorbic acid.

The importance of analyzing raw and cooked foods for dehydroascorbic acid is demonstrated. The general assumption has been that this form of the vitamin is equally as well utilized as is reduced ascorbic acid. Since evidence on this point is incomplete, the utilization of dehydroascorbic acid by human subjects is now being investigated in this laboratory.

References

1. Loeffler, H. J., and Ponting, J. D. *Ind. eng. Chem.* (Anal. ed.), 1942, 14, 846.
2. McMillan, T., and Todhunter, E. N. In press.
3. Roe, J. H., and Oesterling, M. J. *J. biol. Chem.*, 1944, 152, 511.

Buckwheat as a Source of Rutin

James F. Couch, Joseph Naghski, and
Charles F. Krewson

Eastern Regional Research Laboratory,[1] Philadelphia

The recent discovery that the flavonol glucoside, rutin, is effective in the treatment of increased capillary fragility associated with hypertension (*2*) in man has led to a widespread demand for supplies of the drug by physicians and pharmacologists. Preliminary reports indicate that rutin therapy is successful in controlling conditions due to this type of fragility, such as certain cases of retinal hemorrhage and apoplexy.

In this laboratory, rutin was first isolated from tobacco, and the glucoside supplied for the early clinical experiments was prepared from the flue-cured type of high quality. The low yields from an expensive raw material were reflected in a high cost for the product. It was, therefore, desirable to find a more economical source for the glucoside.

A number of plants were examined for rutin content in the course of this research. Of all the species examined, buckwheat is the most promising source yet discovered.

Rutin was first discovered in buckwheat by E. Schunck (*3*), who states that he isolated 240 grains of glucoside from 30 pounds of fresh leaves, a yield of 0.11 per cent. Wunderlich (*4*) obtained "more than 2 per cent" from the dried blossoms of the plant. Brandl and Schärtel (*1*) reported 1.78 per cent from fresh leaves, 0.71 per cent from fresh flowers, 0.09 per cent from the stems, and 1.02 per cent from the dried whole plant.

During the Summer of 1944, forty-six collections of buckwheat of the Japanese variety were made from four scattered localities and examined for rutin.[2] The results showed that the content of rutin was often considerably in excess of that indicated in the earlier reports. In four cases, yields of more than 6 per cent were recorded, and the over-all average for all samples was definitely higher than previously reported.

TABLE 1

Rutin Content of Fresh Buckwheat

Part	Number of samples	Rutin content*		
		Average	Maximum	Minimum
		Per cent	Per cent	Per cent
Whole plant†	28	2.07	8.56	0.48
Leaves and blossoms	13	2.50	6.37	1.16

*Moisture-free basis.
† Exclusive of roots.

The leaves contain more rutin than other tissues of the plant. In one case, the leaves and blossoms together contained 6.37 per cent rutin, the leaves 7.92 per cent, and the blossoms 4.15 per cent. The stems contain only small quantities, 0.4 per cent being the largest found. The seeds and flour were free of rutin.

An experiment conducted with one crop and in a single season indicated that the rutin content varies with the age of the plant, being greatest in the early blossoming stage. Collections of the whole plant, minus roots, were made weekly throughout the growing season until the plant had gone to seed. The rutin content was determined for each collection. The results are presented in Table 2.

TABLE 2

Variation of Rutin Content of Buckwheat With Age of Plants

Time from planting (days)	Stage of maturity of plants	Moisture, per cent	Rutin,*† per cent	Rutin per plant, mg.	Rutin, per acre, lbs.
12	4-leaf	91.2	0.92	0.87	1.86
19	6-leaf, flower buds forming	89.5	2.50	5.4	10.86
26	1–3 blossom heads in bloom	87.9	2.98	6.9	14.18
33	24″–30″ tall, in bloom	91.9	2.47	19.1	39.3
40	36″ tall, in bloom	86.9	1.76	24.2	50.25
47	Seeds setting	85.0	1.21	23.5	48.5
54	All seeds set, one-fourth dark	78.6	0.99	27.3	56.3
61	About one-half of seeds dark	80.2	0.62	19.0	39.2
68	All seeds dark	77.8	0.47	19.5	40.2

* Average of duplicate analyses.
† Moisture-free basis.

The data show the rapid increase in rutin content, which reached a maximum in 23 days after emergence from the ground (26 days after planting) and thereafter declined gradually as the plant went to seed. A part of the decrease in rutin concentration was due to the relatively faster growth of stem tissues, which contain less rutin than the leaves and blossoms, and later in the season, to atrophying of leaf tissues and replacement of blossoms by seeds. The weight of rutin per plant, however, reached a maximum in 37 to 51 days from emergence and then was 3.5 to 4 times as great as at the time of greatest concentration, the plants having increased 6 to 12 times in weight during the two- to four-week period. On an over-all yield basis, one acre of buckwheat in 26 days from planting would produce 14.2 pounds of rutin, while in 40 days the yield would be 50.25 pounds, or approximately 3.5 times as much.

---

[1] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

[2] The method of analysis was essentially that of C. E. Sando and J. U. Lloyd. *J. biol. Chem.*, 1924, 58, 737.

Storage of the crop presents some difficulties because of the tendency of rutin to disappear as the plant dries. Buckwheat exposed to the sun as in haymaking does not dry quickly or thoroughly and loses rutin rapidly. Experiments conducted to determine the effect of drying conditions upon the rutin content showed that the loss of rutin usually increased as the drying process was prolonged, especially at moderate temperatures. Some typical cases are presented in Table 3.

TABLE 3

LOSS OF RUTIN ON DRYING BUCKWHEAT

Sample number	Manner of drying	Rutin content* of		Loss Per cent
		Undried plant Per cent	Dried plant Per cent	
82	Dried in air 4 days, then at 110° overnight	2.50	0.71	71.6
84	Dried† at 185° for 22 minutes	2.12	1.36	35.8
84	Dried† at 71° for 185 minutes	2.12	.00	100.
84	Dried at 110° for 19 hours	2.12	0.59	72.2
35	Dried† at 105° for 50 minutes	2.98	0.84	71.9
85	Dried at 92–100° for 4 hours	2.98	0.81	72.8
37	Dried at 92–100° for 6 hours	2.47	1.53	38.1
37	Dried at 105° for 40 minutes	2.47	1.52	38.1

* Moisture-free basis.
† Chopped.

When the buckwheat is thoroughly dried the rutin content appears to be stable, no loss being observed in specimens stored for six months or more.]

References

1. BRANDL, J., and SCHÄRTLE, G. *Arch. Pharm.*, 1912, **250**, 414–417.
2. GRIFFITH, J. Q., JR., COUCH, J. F., and LINDAUER, M. A. *Proc. Soc. exp. Biol. Med.*, 1944, **55**, 228–229.
3. SCHUNCK, E. *Mem. lit. phil. Soc. Manchester*, 1860, Ser. 2, 15, 122–129.
4. WUNDERLICH, A. *Arch. Pharm.*, 1908, **246**, 241–256.

Thiamine Depletion of Human Subjects on a Diet Rich in Thiamine[1]

HELEN T. NESS, ECHO L. PRICE, and
HELEN T. PARSONS
Department of Home Economics, University of Wisconsin

Studies on thiamine balance in human subjects have usually been carried out with restrictions in dietary intake, with recovery or therapeutic test doses administered after deficiency symptoms have been produced, or, more recently, with enzymatic destruction of thiamine in the digestive tract.

In this laboratory it has been found that by supplementation of an adequate basal diet with certain viable fresh bakers' yeasts it is possible to produce within a period of days a strikingly low excretion of urinary thiamine. In a series of nine tests, five college women in a satisfactory nutritional state were fed a basal diet consisting of bread, pineapple, and dairy products which provided 1.6 mg. of thiamine per day. In order to further insure satisfactory body stores 2 mg. of thiamine hydrochloride were added daily to the subjects' self-selected diets for a 3-day period 24 hours prior to ingestion of the basal diet. The diet sequence was one of three periods: a yeast-supplement period during which either 15 or 150 grams of the live, fresh bakers' yeast containing 7 μg. of thiamine per gram, of a yeast type previously shown not to yield its thiamine for absorption (*4*), was ingested *in addition to the basal diet*; the yeast period was immediately preceded and followed by a yeast-free basal period.

The interference of the yeast with the availability of dietary thiamine from other sources and the resulting decrease in thiamine output are recorded in Table 1. The trend was obvious during the 15-gram dosage as well as on 150 grams of yeast. The sharpest decline occurred in all cases within the first 4 days after which fluctuations at the low level of approximately 50 μg. of thiamine excretion persisted in the case of the larger dosage, a decline twice as great as that produced by the smaller amount. In like manner, when the larger amount was continued for 10 instead of 6 days, the recovery of higher urinary concentrations upon resumption of the yeast-free diet was measurably slow, indicating a possible depletion of body stores. That the interference was a function of the viability of the yeast was indicated not only by the greater decrease in urinary thiamine excretion on the larger dosage, but also by the decided increases in the output when the fresh yeast was heated to the temperature of boiling water just before ingestion (Table 1). It should be noted that the yeast was fed immediately before each meal to permit the possibility of blending with the food. The capacity for viable yeast to withdraw thiamine from a surrounding medium has been well authenticated (*1*). Fecal thiamine concentrations observed during the various periods showed an inverse relationship to urinary thiamine concentrations, indicating that this is a withholding process by the viable yeast rather than destruction within the digestive tract.

---

[1] This work was supported in part by a grant from the Wisconsin Alumni Research Foundation and in part from Purnell funds and a grant from the Pineapple Research Institute of Hawaii.

TABLE 1

URINARY THIAMINE* EXCRETION ON YEAST-SUPPLEMENTED DIET

Period	Days of period	Grams yeast ingested		
		15 grams (3 subj.)	150 grams 3 subj.†	150 grams (3 subj.)
		µg. thiamine/ day	*µg. thiamine/ day*	*µg. thiamine/ day*
Basal	3 or 6 days	374‡	312‡	332‡
Basal plus live yeast	6 or 10 days	217	168	161
		178	124	100
		158	107	99
		163	84	29
		163	52	49
		101	50	83
		...	...	62
		...	...	49
		...	...	42
		...	...	40
Basal	3 days	212	189	80
		227	232	141
		242	257	198
Basal plus boiled yeast	3 days		372	
			712	
			702	

* Thiochrome Assay Method.
† Two subjects, only, ingested boiled yeast.
‡ Values are daily averages for entire period.

While the low values observed in the present experiment do not approach the zero excretions reported in long-term investigations such as those of Keys (*3*) with acute deprivation of B-vitamins following a long period of mild depletion, they are within the range accepted as denoting "considerable to severe deficiency" (*2*).

This procedure may possibly have an application in certain short-term experiments, in that rapid depletion of thiamine may be achieved without the use of a quantitative or deficient diet, and thiamine stores may be quickly regained by merely discontinuing the yeast from the basal adequate diet.

References

1. HOCHBERG, M., MELNICK, D., and OSER, B. *J. Nutrition*, 1945, **30**, 201.
2. HOLT, L. E. *Proc. Fed. Amer. Soc. exp. Biol.*, 1945, **3**, 168.
3. KEYS, A., HENSCHEL, A., TAYLOR, H. L., MICHELSON, O., and BROZEK, J. *Amer. J. Physiol.*, 1945, **144**, 5.
4. WILLIAMSON, A., and PARSONS, H. T. *J. Nutrition*, 1945, **29**, 51.

Effect of Methionine Supplements on Hepatic Injury Produced by Carbon Tetrachloride[1]

VICTOR A. DRILL and TED A. LOOMIS

Department of Pharmacology, Yale University School of Medicine

It was first observed by Hershey and subsequently by Best and collaborators that choline exerts a lipotropic effect. Since then numerous studies have been performed on the relation of choline, methionine, and cystine to fat metabolism with special reference to hepatic changes (*6*). However, little work has been reported on the relationship of dietary choline and methionine to functional changes in the liver. It was demonstrated by Hough and Freeman (*4*) that removal of protein from the diet resulted in an increase in serum phosphatase and a decreased hepatic clearance of dye. They later reported that choline chloride prevented these changes during the first 8 weeks of the deficient diet (*5*). It is also known that such protein-depleted dogs are more susceptible to hepatic poisons. Miller and Whipple (*7*) noted that the toxicity of chloroform in protein-depleted dogs was decreased when methionine was administered either before or up to four hours after the chloroform anesthesia. The methionine-treated animals survived a period of anesthesia lethal to untreated animals. In similar studies Goodell, *et al.* demonstrated that the rise in icterus index following the administration of mapharsen to protein-depleted dogs was lessened when methionine was also given (*2*).

In the above experiments the beneficial effects of methionine were obtained in animals maintained on practically protein-free diets. It is of interest to determine if methionine supplements to a normal protein diet exert any protective action against hepatic toxins. No studies have appeared on this subject, and the following data, pertinent to this question, are reported.

Liver damage was produced by administering small doses of carbon tetrachloride to healthy, adult dogs. The CCl_4 was mixed with an equal volume of corn oil and given by stomach tube before the dogs were fed. Changes in hepatic function were studied by means of the bromsulphalein and serum phosphatase tests, as they have been shown to be sensitive methods in detecting liver damage produced by CCl_4 (*1*). Serum phosphatase was determined by the method of Bodansky (*1*) and bromsulphalein retention by the

---

[1] This study was aided by a grant from Eli Lilly and Company, Indianapolis, and by the Fluid Research Fund of Yale University School of Medicine. The authors also wish to thank Eli Lilly and Company and Wyeth and Company for the necessary methionine.

method of Rosenthal and White.[2] The dogs were fed a synthetic diet containing either 41 per cent or 20 per cent of casein.[3] The 20-per cent casein diet is at the lower level of protein intake but is still normal, and either diet will maintain a normal hepatic function in dogs. All animals received the synthetic diet for at least four weeks before CCl_4 was administered. The methionine was injected intravenously, 1.0 gram being dissolved in 20 cc. of distilled water.

Experiment 1. In this initial study the dogs received the 41-per cent casein diet. One-half cc. of CCl_4 per kilo of body weight was administered on days 1 and 5 of the study and liver function tests performed on the eighth day (Table 1). The methionine-treated animals received 1.0 gram on days 1, 2, 5, and 6. No protective effect of the methionine on liver function was observed (Table 1).

Experiment 2. It was thought that methionine may not exert any protective effect when supplementing a 41-per cent casein diet. Therefore, in this study the amount of casein was reduced to 20 per cent. The dose of CCl_4 was also reduced to 0.25 cc. per kilo of body weight and administered on days 1, 3, and 5. Hepatic function tests were performed two days after each preceding dose of CCl_4 (Table 1). Of the methionine-treated dogs, No's 11 and 12 received 1.0 gram of methionine morning and afternoon each day, starting with the first administration of CCl_4. Animal No. 10 received only 1.0 gram of methionine every day. No significant protective effect of the methionine on hepatic function was noted (Table 1).

Experiment 3. It was possible that the dose of CCl_4 in the previous experiment was too high and might overshadow any effect of the methionine. Therefore in this study the amount of casein was reduced to 20 per cent. The dose of CCl_4 was also lowered to 0.125 cc. per kilo of body weight and administered on days 1, 3, 5, and 7. Hepatic function tests were performed on days 3, 5, 7, and 9. Two grams of methionine were injected each day as in Experiment 2. The methionine was not observed to exert any protective effect on the hepatic functions tested (Table 1).

TABLE 1

EFFECT OF CARBON TETRACHLORIDE AND METHIONINE ON BROMSULPHALEIN RETENTION AND SERUM PHOSPHATASE

Days of Exp.		Bromsulphalein retention							Serum phosphatase						
		CCl_4				CCl_4 + methionine			CCl_4				CCl_4 + methionine		
Exp. 1. 41% casein diet, 0.5 cc. CCl_4/kg.															
	Dog No.	1	2	3	4	5	6		1	2	3	4	5	6	
Control		2	3		5	3	2		4.40	2.67		4.60	3.15	5.13	
Control		2	2	4	4	2	2		4.38	3.03	4.50	4.99	1.45	2.10	
8		20	38	14	14	40	38		23.75	4.90	4.70	5.62	20.48	20.00	
Exp. 2. 20% casein diet, 0.25 cc. CCl_4/kg.															
	Dog No.	7	8	9		10	11	12	7	8	9		10	11	12
Control		2	4	3		3	4	2	5.75	3.95			4.55	2.40	5.25
Control		3	5	3		4	4	4	5.25	3.38	6.75		4.65	4.15	4.50
3		3	6	40		8	2	8	4.00	1.88	10.71		6.50	3.00	9.67
5		24	60	60		8	60	40	6.36	4.88	16.75		5.00	3.58	9.50
7		95	90	95		95	95	60	16.70	7.50	26.80		17.50	10.50	18.15
Exp. 3. 20% casein diet, 0.125 cc. CCl_4/kg.															
	Dog No.	13	14	15		16	17	18	13	14	15		16	17	18
Control		3	2	8		3	2	2	4.25	3.88	5.00		4.28	5.64	5.75
3		4	3	5		6	5	6	3.95	3.68	5.08		5.03	4.50	5.38
5		22	6	5		38	45	6	8.43	3.00	5.60		6.75	8.00	4.00
7		45	10	4		80	50	18	6.25	2.75	3.75		9.50	9.88	6.25
9		95	18	25		24	100	60	6.75	4.00	3.57		6.63	8.18	8.50

It has been definitely shown that the reduced hepatic resistance to chloroform and mapharsen in dogs fed a protein-free diet can be counteracted by the administration of methionine (*2*, *7*). Under the conditions of the above experiments methionine did not exert any demonstrable protective effect on the hepatic damage produced by CCl_4 in dogs fed a normal amount of protein, either 20-per cent or 41-per cent casein. This can be seen with both the bromsulphalein and serum phosphatase tests. Generally the bromsulphalein test became abnormal before or at the same time as the serum phosphatase values, confirming previous results with these two tests. In only one dog (No. 12) did the phosphatase values become abnormal before the dye test. Some variation is present in that one methionine-treated dog (No. 10) maintained a normal liver function longer than untreated controls. However, the variation was such that in the other two experiments the dogs receiving methionine showed a somewhat earlier and greater degree of liver damage.

---

[2] The *customary dose of 5 mg./kilo of body weight was injected instead of the original 2-mg. dose. A single blood sample was taken one-half hour later, and the concentration of dye present divided by 2½.

[3] Diet consisted of: casein, 41.2 per cent; sucrose, 33.4 per cent; lard, 21.5 per cent; bone ash, 2.6 per cent; salt mixture (Karr), 1.8 per cent. In the 20-per cent casein diet the sucrose was increased to 54.6 per cent. Four grams of brewer's yeast concentrate was given each day to supply the B vitamins, and 10 drops of oleum percomorphum were added to each kilo of diet.

This failure of supplementary methionine in a normal protein diet to protect against CCl_4 liver damage may be likened to the failure of supplementary thiamine to produce any added effect in the presence of an adequate vitamin intake. From the present experimental studies one would expect a beneficial effect of methionine or choline on an abnormal hepatic function only in the face of a previous history of protein deficiency. To date three studies have failed to find any beneficial effect of methionine or choline in homologous serum jaundice (*11*) or in infectious hepatitis (*3, 12*). On the other hand, choline, in combination with high protein and high vitamin diets, has been reported to be of value in the treatment of hepatic cirrhosis (*8, 10*), but not all are in agreement with this point (*10*). Experimentally, a protective effect of supplements of methionine added to a normal diet might later be demonstrated with another type of liver damage. The above experiments are fairly acute, and when larger amounts of methionine are available some effect may be demonstrated on a more chronic liver damage. Studies on hepatic repair are also needed as previous studies are all prophylactic in nature.

Summary. At the present time the experimental evidence demonstrates that supplements of methionine will decrease the degree of liver damage produced by toxic agents in protein-depleted animals. In animals receiving a normal protein intake of 20-per cent or 41-per cent casein, methionine supplements did not decrease the degree of hepatic damage produced by carbon tetrachloride as judged by serum phosphatase values or bromsulphalein retention.

References

1. Drill, V. A., and Ivy, A. C. *J. clin. Invest.*, 1944, **23**, 209.
2. Goodell, J. P. B., Hanson, P. C., and Hawkins, W. B. *J. exp. Med.*, 1944, **79**, 625.
3. Higgins, G., O'Brien, J. R. P., Peters, R. A., Stewart, A., and Witts, L. J. *Brit. med. J.*, 1945, **1**, 401.
4. Hough, V. H., and Freeman, S. *Amer. J. Physiol.*, 1942, **138**, 184.
5. Hough, V. H., Monahan, E. P., Li, T., and Freeman, S. *Amer. J. Physiol.*, 1943, **139**, 642.
6. McHenry, E. W., and Patterson, J. M. *Physiol. Rev.*, 1944, **24**, 128.
7. Miller, L. L., and Whipple, G. H. *J. exp. Med.*, 1942, **76**, 421.
8. Rimmerman, A. B., Schwartz, S. O., Popper, H., and Steigmann, F. *Amer. J. digest. Dis.*, 1944, **11**, 401.
9. Rosenthal, S. M., and White, E. C. *J. Amer. med. Ass.*, 1925, **84**, 1112.
10. Russakoff, A. H., and Blumberg, H. *Ann. int. Med.*, 1944, **21**, 848.
11. Turner, R. H., Snavely, J. R., Grossman, E. B., Buchanan, R. N., and Foster, S. O. *Ann. int. Med.*, 1944, **20**, 193.
12. Wilson, C., Pollock, M. R., and Harris, A. D. *Brit. med. J.*, 1945, **1**, 399.

In the Laboratory

Inhibition of Oxidation of Ascorbic Acid by Certain Vegetable Extracts

Ruth Reder

Oklahoma Agricultural Experiment Station, Stillwater

Aqueous extracts of a number of vegetables exert an inhibitory effect on the oxidation of ascorbic acid. Evidence of this effect was first obtained when, to avoid errors in sampling, an attempt was made to use an extract of cabbage, rather than the vegetable itself, in a study of the effects of various compounds on the oxidation of ascorbic acid during boiling. When an aqueous extract of cabbage containing added ascorbic acid was boiled, it was observed that only a small percentage of the vitamin was oxidized. The inhibition of oxidation was found not to be caused by a hydrogen-ion concentration unfavorable to the oxidation, although it was influenced by this factor; nor was it an apparent effect resulting from the formation or release of ascorbic acid or other reducing substances during boiling. Similar aqueous extracts of other vegetables were found to differ widely in their capacity to inhibit oxidation.

Both fresh and previously boiled extracts produced inhibition; the latter were used in the present experiments. The extracts were prepared by grinding a weighed amount of the fresh vegetable with water in a Waring blendor; the filtrate from the blended mixture was boiled for 30 minutes, chilled, filtered, and made to volume. One milliliter of extract was equivalent to 0.25 gram of fresh material.

Inhibition of oxidation was determined by the difference between the amounts of ascorbic acid oxidized, during the same boiling period, in equal volumes (40 ml.) of two solutions (buffered or unbuffered) containing the same amount of ascorbic acid, but differing in that one solution contained a known amount of vegetable extract. The reaction mixtures, complete except for the ascorbic acid, were brought to boiling in uncovered 150-ml. beakers containing glass beads, and a known amount of ascorbic acid solution added to each. At the end of the boiling period, an equal volume of 6-per cent metaphosphoric acid was added to each solution. The solutions were cooled and their ascorbic acid content determined by the titration method.

The inhibition produced by a given amount of extract was found not to be affected by the length of the boiling period; the percentage inhibition produced in triplicate reaction mixtures, boiled for 5-, 10-, and 15-minute periods, was constant. It was influenced, however, by the amount of ascorbic acid present. In buffered (pH 5.7) reaction mixtures containing 1.0 mg. of ascorbic acid, 2 ml. of extracts of lettuce, cabbage, and cauliflower produced 50.0, 79.2, and 91.7 per cent inhibition, respectively, while in similar reaction mixtures containing 8.0 mg. of ascorbic acid these extracts produced 16.0, 53.8, and 71.7 per cent inhibition, respectively.

In reaction mixtures containing a fixed amount of ascorbic acid, increasing amounts of an extract produced an increasing inhibition until a maximum was reached. The maximal inhibition produced by extracts of different vegetables varied: in unbuffered reaction mixtures containing 1.0 mg. of ascorbic acid the maximal inhibition produced by extracts of 10 vegetables ranged from 86 to 47 per cent. The vegetables, when listed according to their decreasing capacity to inhibit the oxidation of ascorbic acid, fall in the following order: Brussels sprouts, green beans, squash, Irish potatoes, broccoli, cauliflower, cabbage, spinach, sweet potatoes, and lettuce. Extracts of all but the last three vegetables produced an inhibition of 70 per cent or more. Two to 4 ml. (0.5–1.0 gram of fresh material) were required to produce maximal inhibition.

The inhibition produced by the extracts was closely associated with copper. In reaction mixtures containing fixed amounts of ascorbic acid and vegetable extract, the percentage inhibition was found to decrease as the amount of copper, added as $CuCl_2H_2O_3$, was increased. Conversely, in solutions containing fixed amounts of ascorbic acid and of added copper, increasing amounts of extract produced an inhibition which increased until a maximum was reached; the maximal inhibition produced varied with the level of added copper.

Results of experiments carried out with extracts at room temperature have confirmed those obtained during boiling. For example, unbuffered reaction mixtures of equal volume (50 ml.) containing 5 mg. of ascorbic acid and 2.0 ml. of extracts of cauliflower and cabbage retained 52.4 and 44.7 per cent, respectively, of their ascorbic acid content after standing at room temperature for 9 hours, whereas only 9.6 per cent of the vitamin remained in a control solution containing no vegetable extract. In similar solutions containing 20 µg. of added copper 16.6, 5.4, and 0 per cent, respectively, of the ascorbic acid was retained after 9 hours.

Of a number of substances examined, those containing either or both the -SS- and -SH groups have been found to exert an inhibitory effect during boiling similar to that exhibited by aqueous extracts of vegetables; these were cystine, cysteine, and an aqueous extract of papain (either fresh or previously boiled). It appears possible that the inhibition of oxidation of ascorbic acid by vegetable extracts may be attributed, in part, to the presence of these groups.

The Use of 2,4-Dinitrophenylhydrazine for the Determination of Ascorbic Acid[1]

M. Pijoan, Lt. Cdr. (MC), USNR, and H. J. Gerjovich, PhM2/c V6 SV, USNR
Naval Medical Research Institute, Bethesda, Maryland

The assay of ascorbic acid by the method of Roe and Kuether (*6*) is based on the reaction of dehydroascorbic acid with 2,4-dinitrophenylhydrazine to form an osazone which, on treatment with sulfuric acid, results in a colored dehydration product. This procedure, when used for blood as recommended by Roe and Kuether, gives excellent results. When applied to certain freshly prepared synthetic or biologically derived ascorbic acid solutions, it gave results which generally conformed to the values obtained by using the oxidation-reduction indicator 2,6-dichlorobenzenone indophenol and those obtained by biological assay (*5*). Thus, so far, it appears reliable for blood and for certain freshly prepared biological materials.

This communication concerns itself with errors inherent in the procedure if applied to biological material or ascorbic acid solutions where unpredictable antecedent oxidation of the vitamin has occurred. We were surprised when a 10-day stock preparation of orange juice, which had been sufficiently aerated to oxidize most of the ascorbic acid (0.2 mg. per cent remaining unoxidized) but which contained 60–70 mg. per cent of "vitamin C" (as dehydroascorbic acid) as determined by the phenylhydrazine method (*6*), failed to prevent the occurrence of scurvy in guinea pigs on a vitamin C-free diet. It was the purpose of the original experiment to demonstrate that the vitamin C potency of a food was not dependent entirely on its ascorbic acid content. The animals received a daily intake of 1.5 mg. of presumed dehydroascorbic acid and yet developed the gross and microscopic lesions of scurvy in four weeks, whereas the control group on a similar amount of the vitamin in fresh juice did not become diseased. The orange juice was then treated with H_2S (*2*) and found to contain only 4 mg. per cent of dehydroascorbic acid. It seemed unlikely, therefore, that the high value obtained by the phenylhydrazine method was due to vitamin C (to include ascorbic acid and dehydroascorbic acid). It was more likely that mutarotation had occurred with loss of lactone structure (*2*) and formation of diketogulonic acid. Similar results, obtained with synthetic ascorbic acid, are presented in Table 1.

---

[1] The statements and opinions set forth in this article are those of the authors and not necessarily those of the Navy Department.

TABLE 1

ASSAY VALUE OF SYNTHETIC ASCORBIC ACID
(Unbuffered in aqueous systems)
Water Bath Temperature 38° C.
Mg./100 ml.

Gas	Ascorbic acid (reductone)		Dehydroascorbic acid (by H_2S)		Total vitamin C content of fluid		Value obtained by dinitrophenylhydrazine		Final H-ion concentration pH	
Gas used	N_2	O_2	N_2	O_2	N_2	O_2	N_2	O_2	N_2	O_2
(Time)										
Initial	22.6	19.4	1.8	4.06	24.4	23.46	27.0	27.0	5.02	4.97
2 hours	12.8	0	4.4	7.0	17.2	7.0	26.0	23.0	5.05	5.05
4 hours	7.2	0	5.6	5.2	12.8	5.2	27.0	21.5	5.32	5.30
6 hours	5.2	0	6.8	7.0	12.0	7.0	26.0	20.0	5.50	5.50

H-ion concentration of glass distilled water = pH 6.22.

No extraordinary precautions were taken other than the meticulous cleansing of glassware throughout. However, catalytic oxidation and not autoxidation occurred, because at this hydrogen-ion concentration there should have been little or no change in ascorbic acid values when aerated with nitrogen (*1*).

From these data it is apparent that the phenylhydrazine reaction is not necessarily specific for dehydroascorbic acid. This is borne out by previous studies which show that 2,4-dinitrophenylhydrazine reacts with diketogulonic acid (*3*), possibly phenylpyruvic acid (*4*), and other alpha-keto acids (*7*).

Thus, the 2,4-dinitrophenylhydrazine method may give unreliable results for the antiscorbutic value of certain biological preparations if loss in lactone structure of dehydroascorbic acid has taken place. Its use for the laboratory evaluation of blood and possibly urine is warranted (*5*); other biological tissues must be assayed with caution in regard to oxidation products of ascorbic acid or other substances entering into the phenylhydrazine reaction.

References

1. BARRON, E. S. G., DEMEIO, R. H., and KLEMPERER, F. *J. biol. Chem.*, 1936, **112**, 625.
2. HIRST, E. L. *Fortschritte der Chemie Organischer Naturstoffe.* Wien, 1939.
3. PENNEY, J. R., and ZILVA, S. S. *Biochem. J.*, 1943, **37**, 39.
4. PENROSE, L., and QUASTEL, J. H. *Biochem. J.*, 1937, **31**, 266.
5. PIJOAN, M., CATCHPOLE, H. R., and HAUGEN, G. Naval Medical Research Institute report to the Bureau of Medicine and Surgery, U. S. Navy, 1944, X–333, No. 1 (open).
6. ROE, J., and KUETHER, C. A. *J. biol. Chem.*, 1943, **147**, 399.
7. SEALOCK, R. R., and SILBERSTEIN, H. E. *J. biol. Chem.*, 1940, **135**, 251.

News and Notes

Dr. Margery C. Carlson, assistant professor of botany at Northwestern University, has been granted leave for three months to undertake an expedition collecting plants in the region of Ahuachapán, El Salvador, close to the Guatemalan border. The expedition is a joint research project sponsored by the Chicago Natural History Museum and Northwestern University. Mr. Paul C. Standley of the Museum suggested this area for study because of its accessibility and because its floristics are practically unknown. The plants collected will fill an important gap in our knowledge of the flora of Central America. Special attention will be paid to the flowering plants of the region. In addition, effort will be made to get representative samples of algae, fungi, and certain forms of beetles. Dr. Carlson was accompanied by Miss Kate Staley, who will assist her in the field work. Guides and native helpers will be secured locally. This expedition is of considerable interest, not only because the territory is practically unexplored botanically, but also because Dr. Carlson is perhaps the first woman to lead a natural scientific expedition to El Salvador.

Dr. C. G. Brennecke, head of the Electrical Engineering Department, North Carolina State College, delivered a lecture on 10 January before the Sigma Xi Chapter of North Carolina State College. Dr. Brennecke spoke on "Atomic Energy."

Announcements

The Associated Press carried a dispatch from Canberra on 28 December 1945 declaring that "Australian scientists" had announced a new drug, paludrine, "which rendered malaria no more harmful than a common cold."

Richardson, Bellows, Henry and Company, Inc., personnel research analysts and consultants, have opened offices at 56 Beaver Street, New York 4, New York. The company will engage in the construction of aptitude, technical knowledge, interest, and personality tests, the development of directed interviewing methods and merit rating procedures, and the conduct of employee attitude and market surveys. Lt. Col. Marion W. Richardson, chairman of the Board of Directors, has served during the war as chief of Personnel Research, The Adjutant General's Office, War Department. Drs. Robert J. Wherry, Edward E. Cureton, Roger M. Bellows, Harold A. Edgerton, Douglas H. Fryer, Edwin R. Henry, Paul Horst, Herman H. Remmers, Robert C. Rogers, and Carroll L. Shartle are also associated with the company in various capacities.

Tuskegee Institute has received a grant of $5,400 from Swift and Company for research in animal nutrition. The grant covers a period of two years, and the specific problem is concerned with the "Mung Bean and Other Special Proteins for Poultry Feeding." The research will be directed by Dr. W. E. Belton, associate professor and head of the Department of Chemistry, with the assistance of Mr. E. J. Jefferson, assistant professor of poultry husbandry. The grant includes stipends for two graduate research assistants, one in chemistry and one in poultry husbandry. Dr. Belton and Mr. Jefferson are members of the staff of the George Washington Carver Foundation, a research organization of Tuskegee Institute founded by Dr. Carver in 1940 with an initial gift of $60,000. The research program of the Carver Foundation is concerned largely with the utilization of agricultural resources, with both practical and fundamental emphasis. In addition to research on problems which have developed through its own interests, the Carver Foundation also conducts a limited amount of research for private industry on a commercial basis, which serves as a source of needed income as well as to provide industrial experience for graduate students majoring in industrial chemistry.

Michigan State College has announced a gift of $15,600 from Swift and Company, Chicago, for a two-year study of the microscopic anatomy of fowl, which will be carried on by the College in cooperation with the U. S. Regional Poultry Research Laboratory.

The Governing Board of the Pan American Union, at its regular monthly session for January, requested the Government of the United States to convoke a Conservation Congress here in June 1947 to consider the problem of the protection and better utilization of this hemisphere's renewable resources.

This action, which was unanimously recommended by the Third Inter-American Agricultural Conference in Caracas, Venezuela, last July, is the result of studies carried on through facilities of the Pan American Union in a number of Latin-American countries and the United States during the past two and a half years. Prepared under the direction of Mr. William Vogt, chief of the Conservation Section, Division of Agricultural Cooperation of the Pan American Union, these studies have revealed such an alarming downward trend in the natural resources of the hemisphere that the conference is projected for the purpose of assembling and coordinating information on natural resources, and the initiation of conservation programs.

Latin America, according to Mr. Vogt, is far from being the rich storehouse of untapped natural resources that many people consider it to be. Vast areas have been deforested, and the destruction of forests is increasing at an accelerated rate. Overgrazing, through the maintenance of excessively large herds of cattle, sheep, and especially goats, is very general. With the destruction of vegetation, soil erosion has become the number one problem in most Latin-American countries. Rivers are silting in some cases, it is believed, at a faster rate than the Mississippi; and floods, resulting from upstream misuse of the land, are becoming increasingly dangerous. Wild life, potentially a very important resource in Latin America, is being exterminated through widespread destruction of habitat and, in many countries, through uncontrolled hunting.

"The Latin American problem," Mr. Vogt stated, "of course parallels the problem in the U. S. It is less serious in North America, however, for two reasons. The first is that public opinion has been sufficiently aroused so that we spend in the neighborhood of $1,000,000,000 a year on conservation, whereas Latin America, with approximately the same population, does not spend 5 per cent of this amount.

"The second advantage possessed by the United States is that it has far greater riches and is a much easier country to live with. Aside from the Argentine pampa, Latin America has no land comparable to our

Middle West. Most of the territory occupied by human beings in Latin America is hilly and subject to such heavy rainfalls that agriculture requires far more advanced practices than have been adopted by Latin American rural populations, or than are likely to be within many years."

The conference will be devoted primarily to field studies of land-use problems, such as sustained-yield forestry, grazing-land administration, national parks, watershed organization and water conservation, wildlife management and soil conservation districts, and perhaps marine and stream fisheries management and research.

"The American Republics," he adds, "are living on their capital and, unless there is a radical change in land management, they will become bankrupt. Within a hundred years, Mexico, for example, will have been largely destroyed. In some of the smaller countries, the situation is probably more serious. The person who knows how to read the land in relation to human occupancy cannot escape the conclusion that in many of our neighboring republics, living standards are steadily falling because of waste of natural resources. The problem is made even more critical by the fact that population trends are, in general, rising."

Dr. William H. Cole, director, Rutgers University Research Council, reports that Rutgers University, nine pharmaceutical manufacturers, and the Army Quartermaster Corps are pooling their knowledge and resources in an extensive cooperative research program which is making basic scientific studies of the properties and therapeutic values of protein hydrolysates and amino acids. When the work started in the Fall of 1943, the Bureau of Biological Research at Rutgers was cooperating with one industrial laboratory and only the equivalent of 5.5 full-time persons and 4 consultants were engaged in the project. Now nine laboratories and the Quartermaster Corps are cooperating in the study, and 24 persons, including 12 full-time investigators and 7 consultants, are participating in the research effort. Studies on the use of proteins, protein hydrolysates, and amino acid mixtures in normal and hypoproteinemic dogs were started to answer basic questions for a better understanding of protein metabolism—questions which must be answered if the use of convalescence is to have a sound basis. It was agreed at the start of the work that the team approach to the problems would be used and that all plans and results would be freely discussed at regular conferences of the Bureau staff and representatives of the cooperating organizations. In addition to frequent conferences for those participating in the project, two larger meetings were held during 1944–1945 so that other persons interested in the work could sit in on the discussions. Mimeographed reports of the proceedings were distributed to those who attended and to others who requested the information.

For the year beginning 1 October 1945, ten groups are cooperating in the project. Rutgers University through its University Research Council is contributing $32,610 and the laboratories $39,000 for the support of the work. The cooperating groups are: Sharp and Dohme Company; Swift and Company; E. R. Squibb and Sons; Arlington Chemical Company; Calco Chemical Company; Inter-Chemical Corporation; Abbott Laboratories; Merck and Company; Eli Lilly and Company; and the Quartermaster Corps of the U. S. Army.

A one-story, fireproof building of about 8,000 square feet of floor space is being planned to house the work and will be built when labor and material conditions permit. It will contain the most modern equipment and facilities for studies of dogs, rabbits, and rats. About one-third of the building will be air-conditioned.

Several scientific reports on the project already have appeared, and others are in preparation. Inquiries concerning the work should be addressed to Dr. James B. Allison, Rutgers University, New Brunswick, New Jersey. Dr. Allison, professor of biochemistry and physiology, is director and coordinator of the program.

Meetings

The Metropolitan Microchemical Society is sponsoring a symposium on microchemistry for the purpose of stimulating interest in this field. The symposium will be held on 1–2 March in Room 319, Roosevelt Memorial Building, American Museum of Natural History, New York City. The program follows:

Friday evening—"Welcome": L. K. Yanowski, Department of Chemistry, Fordham University; "Introduction": Al Steyermark, Microchemical Department, Hoffmann-La Roche, Inc., Nutley, New Jersey; "Weighing on a Micro Scale": L. T. Hallett, General Aniline and Film Corporation, Easton, Pennsylvania; "Microgram Methods": A. A. Benedetti-Pichler, Queens College. *Saturday morning*—"Volumetric Determinations": A. Sobel, Brooklyn Jewish Hospital; "Discussion of the Van Slyke Manometric Blood Gas Apparatus and Its Applications": D. D. Van Slyke, Hospital of the Rockefeller Institute for Medical Research, New York; "Mass Spectrometer": D. Rittenberg, College of Physicians and Surgeons, New York; "Photometric and Spectrophotometric Analysis": D. L. Drabkin, University of Pennsylvania.

Letters to the Editor

Federal Scientific Research

Under the title given above, R. G. Roberts and H. H. Beard (*Science*, 1945, 102, 660) object to a proposal which they attribute to the "Board of Governors of Yale University." There is no such body. Reference to the article cited (*Science*, 1945, 102, 524–525) reveals that the group in question is the Board of Permanent Officers of the Sheffield Scientific School—in other words, the full professors in the Division of Science of the Graduate School, Yale University.

CHESTER R. LONGWELL

Yale University

One World, Yet Different Biologies?

Although in his work, *One world*, the late Wendell Willkie wrote a good bit without saying anything, the concept implied in the title is currently attracting favorable attention, even among political leaders. Of all groups, one might have expected that scientists would be most insistent that there is but a single sort of their particular branch of endeavor—one biology, one chemistry, one physics, and so on.

Accordingly, it has been rather disconcerting to find successive articles appearing in recent issues of *Science* under the title "Soviet Biology." For, the use of a modifying term in this manner implies that there is some other kind of biology which is different and, presumably, *inferior*—perhaps racial, e.g. Polynesian Biology; or religious, as Baha'i Biology; or even, dare we say it, Capitalist Biology.

Mr. Editor, when further articles of this sort reach your desk, would it be too much to ask that you alter the title so that no racial, religious, or political term is permitted to modify the word science, or any branch thereof? If an article is headed "Shangri-La Biology," could it not be changed to "Biology in Shangri-La"?

EDGAR T. WHERRY

Department of Botany, University of Pennsylvania

The Abstracting of Biological Films

The section on visual instruction in *Biological Abstracts* provides a useful service to prospective film users. However, its usefulness would be greatly increased if the coverage could be extended to all biological films. At the present time the section is limited to the fields of microbiology, immunology, and public health, which are reviewed by a committee of the Society of American Bacteriologists headed by Dr. H. E. Morton. Correspondence with the editorial office of *Biological Abstracts* indicates that they are very willing to publish abstracts of all biological films that can be located. Other societies have committees on visual instruction, but they have not been set up to furnish such abstracts. In some cases these committees list approved films for the benefit of the members of their societies. Other films do not appear on the approved lists because of errors or misconceptions within the films. However, the work of such committees would be much more useful if all of this information were made generally available in abstract form to a larger group of film users.

The present abstracts furnish precisely the information that a prospective user needs. By giving the shortcomings and limitations of a film the user can frequently adapt it to his purposes. Although useful information may be obtained from the *Educational Film Guide* published by H. W. Wilson Company, this publication does not ordinarily reach the desk of the biologist, and the information supplied is not complete. Adequate coverage of all biological films in *Biological Abstracts* would serve to keep the biologist abreast of this expanding field. It is to be hoped that the other biological societies may so constitute their committees on visual instruction that a program for abstracting all films of interest to the biologist may ultimately be worked out.

W. MALCOLM REID

Monmouth College, Illinois

Glutamine From Rye Grass

Greenhill and Chibnall (*Biochem. J.*, 1934, 28, 1422–1427) and Curtis (*Plant Physiol.*, 1944, 19, 1–5) noted marked exudation of glutamine on grass fertilized in the spring with nutrients high in ammonia. Greenhill and Chibnall did not get similar results later in the season, and Curtis was unable to reproduce the phenomenon.

In the tomato (G. J. Raleigh. *Plant Physiol.* In press) marked guttation followed the addition of either nitrate or of ammonium salts to solutions deficient in nitrogen. With the thought that a period of growth with low available nitrogen and consequent high carbohydrate reserves might be a prerequisite for glutamine exudation, domestic rye grass was seeded 25 September 1944, in flats with hardware cloth bottoms containing 1½ inches of potting soil. The flats were kept in the greenhouse until 28 October when they were moved out-of-doors to a sheltered area. In order to facilitate leaching, they were placed on cinders approximately 8 inches deep.

By 28 March the rye grass had made good growth but was light in color, indicating nitrogen deficiency. From that date to 26 June a total of 52 flats were fertilized with ammonium chloride dissolved in water at the rate of 300 pounds of the dry salt to the acre at 8 different times during that period. In most cases, the grass was clipped before the applications of fertilizer. The NH_4Cl was applied in mid-afternoon on days when the weather prediction indicated a clear, cool night.

Without exception, usually on the first or second day following fertilization, nitrogen-deficient grass produced quantities of exudate sufficient to make it possible to collect it, by clipping and drying the grass, rubbing it lightly, and collecting the dry exudate thus dislodged. One lot so collected was dissolved in water so as to float and settle off the particles of grass and part of the solution treated for two hours at 100° C. at pH 6.5 in accordance with the methods of Vickery, *et al.* (*Biochem. J.*, 1935, 29, 2710–2720). A marked increase in ammonia following the treatment indicated the presence of glutamine. A total of 12 flats fertilized at three different times while the grass was making rapid growth of dark green color following earlier applications of NH_4Cl produced relatively little or no white exudate.

G. J. Raleigh

Cornell University

Captain Jenkins' Views

The objections of Captain John G. Jenkins, USNR, to the universal application of statistical methods to research in psychology probably are well taken. Indeed, these objections may well be extended to many fields of scientific endeavor and to many methods of research. Any circumscribed test assumes that certain ideal conditions shall be fulfilled, but in reality the ideal is seldom present or even achievable. Therefore, any single test reveals only one aspect of the situation. Usually the situation is far more complex than we imagine.

The chief injury of the standardized test arises not from its limited nature, but from the mental attitude of investigators that all research must be fitted to some particular test. However, all tests are only tools and like machine tools they are useful in some, but not in all, situations. Years ago Fabre pointed out this discrepancy between the ideal tool and the actual situation. Although the inimitable observer failed to appreciate the marvelous adaptability of Darwin's theory, his words from "A dig at the evolutionists," translated by Alexander Teixeira De Mattos, are applicable to the present situation:

"But to this calculus, all-powerful so long as it does not leave the domain of the ideal, let us submit a very modest reality: the fall of a grain of sand, the pendular movement of a hanging body. The machine no longer works, or does so only by suppressing almost everything that is real. It must have an ideal material point, an ideal rigid thread, an ideal point of suspension; and then the pendular movement is translated by a formula. But the problem defies all the artifices of analysis if the oscillating body is a real body, endowed with volume and friction, if the suspensory thread is a real thread, endowed with weight and flexibility; if the point of support is a real point, endowed with resistance and capable of deflection. So with other problems, however simple. The exact reality escapes the formula."

Paul D. Harwood

Ashland, Ohio

. . . I think *Science* is to be complimented on Captain John G. Jenkins' article (*Science*, 1946, 103, 33–38). The general indictment against the technical man, and it is not without some basis, is that his scientific approaches and thought patterns are devoted to obscure fields without any realization of practical value. While the scientific purity of thought is highly commendable it would appear that some of the effort in that direction would have greater significance if interpreted in the light of some of Captain Jenkins' remarks.

E. C. Koerper, *In Charge of Special Engineering*
A. O. Smith Corporation, Milwaukee, Wisconsin

Pancreatic Enzymes and Liver Fat

The late Dr. A. H. Palmer was well known for his work on the proteins of milk whey. He joined this department in September 1944 and undertook at my suggestion the separation and identification of enzymes present in the antifatty liver fraction of pancreas, prepared by the method of Entenman and Chaikoff (*J. biol. Chem.*, 1941, 138, 477). Palmer's work was hampered by ill health and terminated by his death on 10 April 1945. During his short period of application to his new problem, however, he obtained in crystalline form and in fair yield trypsinogen and chymotrypsin from the pancreas extract. He identified these two enzymes to his own complete satisfaction and believed that at least one more proteolytic ferment was present in the extract.

Chaikoff, Entenman, and Montgomery (*J. biol. Chem.*, 1945, 160, 489) state that their findings are consistent with the concept that the antifatty liver factor (of pancreas) is enzymatic in nature. The results of Palmer's work provided evidence in support of this view, and it is most regrettable that his notes are not sufficiently complete to enable us to make a detailed report of his findings. Some of his preparations are still available, however, and it may be possible to complete certain aspects of his work.

The probability that the enzymes contained in the pancreas which is fed to depancreatized dogs contribute very significantly to the total lipotropic effect by releasing lipotropic factors from the various constituents of the diet has been emphasized in previous reports from Chaikoff's and this laboratory. The possibility that these enzymes played a role in the prevention of fatty livers in insulin-treated depancreatized dogs was, of course, mentioned and seriously considered by Prof. J. J. R. Macleod and his collaborators in the original work in this field.

C. H. Best

Banting and Best Department of Medical Research
University of Toronto

Absorption of Phenol Vapors by Plants

An interesting phenomenon concerned with the absorption of phenol-like vapors by plants was observed during the Summer of 1945 in and about Ambler, Pennsylvania. A factory located on the outskirts of Ambler started the commercial production of 2,4-dichlorophenoxy acetic acid (2,4-D). This product has been used as a plant growth regulator and has been developed by the Bureau of Plant Industry, Soils and Agricultural Engineering, as a weed killer.

In the production or purification of the product at

Ambler, phenolic vapors escaped into the atmosphere and were distributed over several square miles of the area surrounding the factory. The concentration of the vapors varied with the atmospheric conditions: on clear days the concentration was slight or not noticeable; on cloudy days with low atmospheric ceilings the vapors were quite noticeable at distances of one to two miles from the factory. The summer in this vicinity was a wet one, the number of cloudy days and nights being above average.

One determination of the concentration of the vapor taken by the Pennsylvania Department of Health at the source is reported equivalent to parts of dichlorophenol at 4 p.p.m. However, at this concentration near the source, the odor is quite noticeable. While the vapors may be objectionable, they have not yet been regarded as a human health hazard, the factory workers having been exposed to these concentrations without any reported ill effects.

On the other hand, the flavors of certain garden vegetable crops grown within the area were affected by the vapors. Tomatoes were especially affected, with string beans, Swiss chard, and lettuce responding in lesser degree. Carrots, beets, potatoes, peppers, and cabbages were apparently not affected.

Samples of vegetables were secured by the writer from gardens located approximately 200, 400, and 600 yards and one mile and one and one-half miles from the factory.

The tomato fruits acquired a pronounced ''medicine'' flavor of phenolic type, yet not unlike that of iodoform, although iodine is not involved in the compound. The concentration of the unusual flavor in the various fruits was inversely proportional to the distance of location of the gardens from the factory. However, wind drift affected the concentration from time to time over the area.

The tomato deposited the flavor in the fruit at all stages of maturity and retained it permanently or until it decayed. Young, quite immature fruit possessed the flavor, which could easily be detected by odor when the fruit was cut or broken open. As the fruit matured on the vine the concentration apparently increased until the fruit was picked. Tomatoes grown at a distance of one or one and one-half miles from the factory, and, where it is believed the concentration of the vapors in the air was usually less than in gardens nearer to the factory, varied in the deposition of phenolic flavor in the several lobes or segments. Whereas one lobe was nearly free of the flavor, another one was quite strong. Fruit produced nearer to the source of the vapors acquired a more uniform deposition. The concentration of the phenolic flavor apparently did not decrease in storage. Contaminated fruits stored for 14 days five miles from Ambler in a normal atmosphere possessed as strong a flavor as when they were picked, as determined by taste tests. Fruits picked green and allowed to ripen in a normal atmosphere for 14 to 21 days seemingly had not lost any of the unusual flavor. Ripe fruits retained the flavor in normal air or refrigerator temperatures. Stewing the ripe fruit intensified the flavor. All fruits were carefully washed and peeled, and in no case was there any noticeable flavor in the skin.

No chemical determination as to character or amount was made of the deposited flavor. Three tolerance tests were made by the writer on three different days, samples being secured from gardens located about one mile from the factory. Twelve ounces of well-colored, ripe fruit that was carefully washed were eaten. Nausea followed within 15 minutes and continued for two to three hours. On alternate days the same experiment was made with an equal weight of ripe tomatoes grown in a normal atmosphere five miles from Ambler. No ill effects were noticed.

String beans grown in the same gardens as were some of the tomatoes also developed off-flavors which were not as strong of phenols as those of the tomatoes. The beans, however, were unpalatable, and several gardeners reported that they had to dispose of their canned crops, as persons eating them were nauseated.

Swiss chard developed a very strong, unpalatable taste. Eating a small quantity induced slight nausea. Lettuce grown within one-quarter of a mile of the source had developed a strong, unnatural off-flavor differing from that of ''bitter'' lettuce.

Samples of tomatoes were secured from several other localities within the Philadelphia metropolitan area where large chemical establishments have ''zones of influence'' and fields and gardens are subjected to vapors of various sorts. In none of the samples secured from these areas was there noticed any unnatural flavor. However, so far as is known, none of these latter factories evolve phenolic-like vapors.

It was not determined whether the vapors were absorbed directly through the leaves or by the roots from accumulations in the soil that may have been collected by the rains and dews.

The abnormal effects were noticed only on the flavor of the fruit or leaves as described above. In no case was there observed any structural deformation on any plants due to the vapors, although 2,4-D and other compounds of the hormone group have the ability to markedly affect plant structure when sprayed on certain plants in very weak concentrations.

It is believed important to call attention to the hazards involved in rendering important crop-producing areas useless by the dissemination of certain industrial vapors even in light concentrations. Following the experience around Ambler in 1945 the factory officials are reported to be active in altering their process so as to prevent any further escape of dangerous vapors.

E. G. BEINHART

Wyndmoor, Pennsylvania

OPTICAL GLASS
FOR THE EYES OF SCIENCE

The optical equipment upon which science is so dependent is, in turn, dependent upon optical glass. Prior to World War I, American-made optical glass was a laboratory curiosity. At that time Bausch & Lomb was able to perfect the methods and formulae with which it had been experimenting for several years . . . producing the first commercial quantities of fine optical glass ever made in this country. Since then, optical glass making at Bausch & Lomb has been continuously expanded until today Bausch & Lomb produces the major portion of the optical glass used in this country . . . each of the many types for its specific optical use. Bausch & Lomb Optical Company, Rochester 2, N. Y.

Illustrated is the largest single usable piece of optical glass ever made in America. Weighing some 379 pounds, after two months of shaping and annealing, it will be ground as a 4° prism for use in the world's largest Schmidt-type telescope, to be erected at Puebla, Mexico.

BAUSCH & LOMB

ESTABLISHED 1853

Book Reviews

Industrial oil and fat products. **Alton E. Bailey. New York: Interscience Publishers, 1945. Pp. x + 735. (Illustrated.) $10.00.**

This volume is an important addition to the literature on oil and fat technology. It brings up to date the description of commercial processes by which both edible and nonedible products of importance are manufactured from fats and oils.

Following a brief section dealing with the composition, reactions, and properties of fats there is a more extensive treatment of the raw materials commonly used commercially, the specific products such as salad oils, shortenings and margarine, soaps and other surface active materials, paints and varnishes, and a group of miscellaneous products. More than one-third of the book is given over to a detailed examination of processes used in the fat and oil industry, including extraction, refining and bleaching, deodorization, hydrogenation, soap working, and polymerization.

Throughout the book the author has used graphs, tables, and formulas to good advantage in presenting and illustrating the text. The end result is that the book is greatly superior as a reference work to any of the publications in this field. The author has gone a long way indeed toward narrowing the gap between existing but scattered knowledge and orderly, readable, and useful assembly for publication. His own long and distinguished association with the field has provided a sound background for the endeavor.

HERBERT E. LONGENECKER

University of Pittsburgh

Vitamins and hormones: advances in research and application. **(Vol. III.) Robert S. Harris and Kenneth V. Thimann (Eds.). New York: Academic Press, 1945. Pp. xv + 420. (Illustrated.) $6.50.**

This volume presents another valuable group of review papers on vitamins and hormones. The reviews are especially valuable because the authors of each chapter are actively engaged in research dealing with the subject concerned. The nine chapters are divided between five chapters dealing definitely with vitamins, three with hormones, and one with the antipernicious anemia substances of liver, which can probably be closely associated with the field of vitamins. Individual chapters differ greatly in length and completeness. The longest and most extensive paper, written by Knight, is on "Growth factors in microbiology," and the shortest, by Dodds, is on "Possibilities in the realm of synthetic estrogens" and deals mainly with the work which led to the recognition of three new synthetic estrogens.

The editors comment in the Preface that the subject matter in the earlier volumes was somewhat unrelated and that more effort to integrate the papers would be made in the future. This integration is already evident in this volume, since the first three chapters deal with very closely related subjects, namely, interrelation of vitamins, synthesis of B vitamins by intestinal bacteria and sulfonamides, and vitamin deficiencies. In fact, there is a little repetition in the subject matter presented in these three chapters, but footnotes are added to correlate the related material. The chapter on the chemistry of antipernicious anemia substances of liver logically follows the chapter in Volume 1 on the physiological and clinical aspects of pernicious anemia and covers very completely the chemical work on the pernicious anemia factor or factors which has been done during the past seventeen years.

The chapter dealing with manifestations of prenatal nutritional deficiency is especially timely and should stimulate further nutritional work with animals beyond the period of rapid growth. Although the chapter on "Growth factors in microbiology" is most extensive, it is interesting to note that little, if any, material on the newer factors, even folic acid, is included. The longer chapters on hormones deal with the action and metabolism of gonadotropic hormones and the role of acetylcholine in the mechanism of nerve activity.

It is interesting to note the interpretations which the reviewers have given to original work. Naturally, one should expect some differences of opinion, but in any review care should be taken to quote correctly from the original papers. It appears that at least one such error has been made in this volume. On page 8 the work of Griffith and Mulford is referred to, and it is stated that they claim that niacin alleviates the severity of the symptoms of choline deficiency in rats. Actually, the authors state that nicotinic acid exerts a moderate choline-opposing action.

C. A. ELVEHJEM

University of Wisconsin

Advances in protein chemistry. **(Vol. II.) M. L. Anson and John T. Edsall (Eds.). New York: Academic Press, 1945. Pp. xiv + 443. $6.50.**

A knowledge of protein chemistry is basic to an understanding of many problems in biochemistry, immunology, and pathology, and is equally indispensable to the control and development of new techniques in certain aspects of the industrial arts. A large and diversified literature on the proteins has accumulated in journals all over the world, and presumably still more data are awaiting their turn to emerge from the archives of the late war effort. Short of turning librarian, it is nearly impossible for the active investigator to keep abreast of this ever-expanding literature. The need for competent reviews on various significant aspects of the proteins has become patent, and the present series on *Advances in protein chemistry* ministers to this need admirably. The editors have exercised a fine discrimination and have achieved a good balance among topics of fundamental and applied interest both in the earlier and in the present volume.

In the present volume there are four reviews on fundamental studies on protein structure or reactivity. "The Reactions of Formaldehyde with Amino Acids and Proteins," by French and Edsall, and the consideration of "X-Ray Diffraction and Protein Structure," by Fankuchen, are masterly presentations of the respective subjects. The success of the former authors in condensing and making clear and readable the vast literature on formaldehyde-protein reactions is noteworthy. The table assembled by Fankuchen on X-ray data on the crystalline proteins is a valuable aid to the reader. In a review on "Protein Denaturation and the Properties of Protein Groups," Anson has made a thoughtful and straightforward presentation of his views on this topic. A discussion on "Terminal Amino Acids in Peptides and Proteins," by Fox, describes some of the methods which might be employed in determining amino acid sequences in proteins.

There are two excellent reviews on tissue proteins, one by Dawson and Mallette on "Copper Proteins," and the other by Karl Meyer on "Mucoids and Glycoproteins." The former covers the topics of the hemocyanins, the oxidases, and metalloproteins generally; the latter is concerned with those polysaccharides and smaller sugars which are attached to a number of proteins. Both reviews should be immensely valuable to workers in many fields.

Two reviews on foodstuffs, "Amino Acid Composition of Food Proteins," by Block, and "Wheat Gluten," by Blish, are interesting contributions to this subject, the tables in both reviews being of particular usefulness to workers in nutrition. The range of problems encountered in cereal technology may be a surprise to those accustomed to the ready availability of bread nicely wrapped in wax paper on the grocer's shelves.

There are two reviews on methods of protein analysis. One, by Snell, on the "Microbiological Assay of Amino Acids" is very well done and of considerable contemporary interest. The other, by Martin and Synge, covers nearly all methods of analysis of hydrolyzed proteins except the microbiological; close to 800 references are cited in 63 pages of text, and the thought arises that perhaps too much has been attempted in too small a space.

A contribution of interest to medicine is a review by Paul Cannon on "Antibody Production and Resistance to Infection," which is largely concerned with the relation of protein metabolism to resistance mechanisms in the animal body.

JESSE P. GREENSTEIN

National Cancer Institute, Bethesda, Maryland

Scanning Science—

The first number of the anthropological series published by the Field Columbian Museum, Chicago, is the "Archaeological Studies among the Ancient Cities of Mexico," by the curator, William H. Holmes. The first part, which alone has appeared, is devoted to the architectural remains of Yucatan.

—21 February 1896

HANDBOOK OF LIZARDS

Lizards of the United States and of Canada

By Hobart Muir Smith

Latest title to be added to the already well-known series HANDBOOKS OF AMERICAN NATURAL HISTORY, edited by Albert Hazen Wright, this Handbook considers 136 species of lizards under the following topics: range, type, locality, size, color, scalation, recognition characters, structural features, life history, habitat and habits, methods of collection and preservation, and problems for future study.

Illustrations, numbering more than 300, consist of photographs, from several views, of practically all species and subspecies, line drawings and range maps. Also included are illustrated keys to all the families, genera, species and subspecies of North American lizards.

The HANDBOOK OF LIZARDS is the first full treatment thus far published of lizards occurring in the United States and in Canada. It will be of particular interest to all herpetologists and students of general zoology, both for field work and as a valuable reference.

To be published in the spring.
Approximately 600 pages,
$5.75 (tentative)

ORDER FROM YOUR BOOKSELLER OR

COMSTOCK PUBLISHING CO., INC.
124 ROBERTS PLACE
ITHACA, NEW YORK

Scientific Book Register

Bamann, Eugen, and Myrbäck, Karl. *Die Methoden der Fermentforschung.* New York: Academic Press, 1945. Vol. I: pp. xx + 1162; Vol. II: pp. 1164–2108; Vol. III: pp. 2110–3047; Vol. IV: pp. 3049–3388. (Illustrated.) $65.00.

Freedman, Samuel. *Two-way radio.* Chicago-New York: Ziff-Davis, 1946. Pp. xxii + 506. (Illustrated.) $5.00.

Johnson, Maxwell O. *Correlation of cycles in weather, solar activity, geomagnetic values, and planetary configurations.* (1st ed.) San Francisco: Phillips and Van Orden, 1946. Pp. xiii + 149. (Illustrated.)

Krafft, Carl Frederick. *Ether and matter.* Richmond: Dietz Printing Co., 1945. Pp. viii + 117. (Illustrated.)

Leffingwell, Georgia, and Lesser, Milton A. *Glycerin: its industrial and commercial applications.* Brooklyn: Chemical Publishing Co., 1945. Pp. 268. (Illustrated.) $5.00.

Macy, Icie G. *Nutrition and chemical growth in childhood: original data.* (Vol. II.) Springfield, Ill.: Charles C. Thomas, 1946. Pp. xxv–xlii + 433–1460. (Illustrated.) $10.00.

O'Neill, John J. *You—and the universe—what science reveals.* New York: Ives Washburn, 1946. Pp. vii + 328. $3.50.

Snedecor, George W. *Statistical methods: applied to experiments in agriculture and biology.* Ames, Ia.: Iowa State College Press, 1946. Pp. xvi + 485. $4.50.

Stokley, James. *Electrons in action.* New York-London: McGraw-Hill, 1946. Pp. x + 320. (Illustrated.) $3.00.

Walls, Gordon Lynn. *The vertebrate eye and its adaptive radiation.* Bloomfield Hills, Mich.: Cranbrook Institute of Science, August 1942. (Bull. No. 19.) Pp. xiv + 785. (Illustrated.) $6.50.

Weidenreich, Franz. *Giant early man from Java and South China.* (Vol. 40, Pt. 1, Anthropological Papers.) New York: American Museum of Natural History, 1945. Pp. 134. (Illustrated.)

Wendt, Gerald, *et al.* (Eds.) *The atomic age opens.* Cleveland: World Publishing Co., 1945. Pp. 251. (Illustrated.) $1.00.

Wolfe, John H., *et al.* *Industrial algebra and trigonometry with geometrical applications.* New York: McGraw-Hill, 1945. Pp. 402. (Illustrated.) $2.20.

Young, C. B. F., and Coons, K. W. *Surface active agents: theoretical aspects and applications.* Brooklyn: Chemical Publishing Co., 1945. Pp. x + 381. (Illustrated.) $6.00.

Catalogue Corner

Laboratory measuring instruments. A catalogue has just been issued by the DeJur-Amsco Corporation covering its line of electrical indicating instruments, potentiometers, rheostats, and photographic apparatus. The catalogue is well illustrated with cuts, graphs, and diagrams that enable the reader to grasp the essential specifications at a glance. Research workers who use photography in their work will be interested in the new exposure meters and enlargers developed by the DeJur laboratories. *Catalogue SC–463.* DeJur-Amsco Corporation, Northern Boulevard at 45th Street, Long Island City, N. Y.

Cathode-ray tube photography. The Eastman Kodak Company is able to supply a brochure on Kodak materials for use in the photography of cathode-ray tubes. The contents as outlined are: types of cathode-ray screens; recording by direct cathode-ray action; camera equipment and technique; criteria for the choice of photographic materials; developing and fixing; formulas and chemicals; effective speeds of Kodak materials; and style number of Kodak recording materials. *Kodak materials for the photography of cathode-ray tubes. Brochure SC–463.* The Eastman Kodak Company, Rochester 4, N. Y.

Biological materials and supplies. The Carolina Biological Supply Company publishes a four-page folder each month in which it gives detailed information about several of the many hundreds of items regularly carried in stock. *Carolina tips* is the title of the folder, which may be obtained from the company. The 1945–46 catalogue of biological materials has also been received. Several thousand items are listed, with descriptions and prices, and many illustrations are used. *Catalogue 17 SC–463.* Carolina Biological Supply Company, Elon College, N. C.

Tweezer spot welding machine. A recent announcement by the Tweezer-Weld Corporation about its new portable welding unit should interest research men both in industry and academic circles. Nearly every laboratory has constant need for a unit to make strong—and in many cases, extremely small—welds. This new unit consists of electrodes fashioned in the shape of tweezers. The leads are covered with a flexible plastic material. According to the specifications, it can be plugged into a 115-volt, 60-cycle power supply and can be adapted easily to 220 volts. *Tweezer spot welding machine. Leaflet SC–463.* Tweezer-Weld Corporation, 280 Plane Street, Newark 2, N. J.

Spectrographic news. The Harry W. Dietert Company issues a news letter describing the products being developed in its laboratories and those of its affiliate, the Applied Research Laboratories of Glendale, California. *Spectrographer's news letter SC–463.* Harry W. Dietert Company, 9330 Roselawn Avenue, Detroit 4, Mich.

SCIENCE

Vol. 103, No. 2669 Friday, February 22, 1946

Remarks on the History of the Exclusion Principle

Wolfgang Pauli

Institute for Advanced Study, Princeton, New Jersey

THE HISTORY OF THE DISCOVERY of the exclusion principle, for which I have received the honor of the Nobel Prize award this year, goes back to my student days in Munich. While, in school in Vienna, I had already obtained some knowledge of classical physics and the then-new Einstein relativity theory, it was at the University of Munich that I was introduced by Sommerfeld to the structure of the atom—somewhat strange from the point of view of classical physics. I was not spared the shock which every physicist accustomed to the classical way of thinking experienced when he came to know of Bohr's "Basic postulate of quantum theory" for the first time. At that time there were two approaches to the difficult problems connected with the quantum of action. One was an effort to bring abstract order to the new ideas by looking for a key to translate classical mechanics and electrodynamics into quantum language which would form a logical generalization of these. This was the direction which was taken by Bohr's Correspondence Principle. Sommerfeld, however, tried to overcome the difficulties which blocked the use of the concepts of kinematical models by a direct interpretation of the laws of spectra in terms of integral numbers, following, as Kepler once did in his investigation of the planetary system, an inner feeling for harmony. Both methods, which did not appear to me irreconcilable, influenced me. The series of whole numbers 2, 8, 18, 32 . . . , giving the lengths of the periods in the natural system of chemical elements, was zealously discussed in Munich, including the remark of the Swedish physicist, Rydberg, that these numbers are of the simple form $2n^2$ if "n" takes on all integer values. Sommerfeld tried especially to connect the number 8 and the number of corners of a cube.

A new phase of my scientific life began when I met Niels Bohr personally for the first time. This was in 1922, when he gave a series of guest lectures at Göttingen in which he reported on his theoretical investigations on the periodic system of elements. I shall recall only briefly that the essential progress made by Bohr's considerations at that time was in explaining by means of the spherically symmetric atomic model the formation of the intermediate shells of the atom, and the general properties of the rare earths. The question as to why all electrons for an atom in its ground state were not bound in the innermost shell had already been emphasized by Bohr as a fundamental problem in his earlier works. In his Göttingen lectures he treated particularly the closing of this innermost K shell in the helium atom and its essential connection with the two noncombining spectra of helium, the ortho- and parahelium spectra. However, no convincing explanation for this phenomenon could be given on the basis of classical mechanics. It made a strong impression on me that Bohr at that time and in later discussions was looking for a general explanation which should hold for the closing of every electron shell and in which the number 2 was considered to be as essential as 8 in contrast to Sommerfeld's approach.

During these meetings in Göttingen Bohr came to me one day, accompanied by his assistant, Oskar Klein (now professor in Stockholm), and asked me whether I could come to him in Copenhagen for a year. He needed a collaborator in the editing of his works, which he wanted to publish in German. I was much

***Professor Wolfgang Pauli was honored for the award of the Nobel Prize* in physics at a dinner on 10 December 1945 at the Institute for Advanced Study, Princeton. Dr. Frank Aydelotte, director of the Institute, welcomed the guests and called on Professor Hermann Weyl to offer a toast, which was seconded by Professor Albert Einstein and Erwin Panofsky. Professor Pauli then gave the principal address.**

***Science* prints an amplified version of Professor Pauli's address together with somewhat shortened accounts of Dr. Aydelotte's introduction and Professor Weyl's encomium.**

surprised, and after considering a little while I answered with that certainty of which only a young man is capable: "I hardly think that the scientific demands which you will make on me will cause me any difficulty, but the learning of a foreign tongue like Danish far exceeds my abilities." The result was a hearty burst of laughter from Bohr and Klein, and I went to Copenhagen in the fall of 1922, where both of my contentions were shown to be wrong. The first words I learned were the integers. The way in which such simple numbers as 50, 70, and 90 are expressed in Danish—in a complicated fashion as half-multiples of 20—particularly impressed me, but I understood the idea and could easily recognize the words. But the half-integers used by Landé as magnetic quantum numbers to explain the anomalous Zeeman effect presented much greater difficulties for me. "Anomalous Zeeman effect" refers to a type of splitting of the spectral lines in a magnetic field which is different from the normal triplet. The anomalous type of splitting was on the one hand especially fruitful because it exhibited beautiful and simple laws, but on the other hand it was hardly understandable, since very general assumptions concerning the electron, using classical theory as well as quantum theory, always led to the simple triplet. A closer investigation of this problem left me with the feeling that it was even more unapproachable. A colleague who met me strolling rather aimlessly in the beautiful streets of Copenhagen said to me in a friendly manner, "You look very unhappy"; whereupon I answered fiercely, "How can one look happy when he is thinking about the anomalous Zeeman effect?" I could not find a satisfactory solution at that time, but succeeded, however, in generalizing Landé's analysis for the simpler case (in many respects) of very strong magnetic fields (*Z. Phys.*, 1923, **16**, 155). This early work was of decisive importance for the finding of the exclusion principle.

When in 1923 Bohr made his first trip to the United States, I returned, as an assistant, to the University of Hamburg, where soon afterwards I gave my inaugural lecture as *Privatdozent* on the periodic system of elements. The contents of this lecture appeared very unsatisfactory to me, since the problem of the closing of the electronic shells had been clarified no further. The only thing that was clear was that a closer relation of this problem to the theory of multiplet structure must exist. I therefore tried to examine again critically the simplest case, the doublet structure of the alkali spectra. I arrived at the result that the point of view then orthodox—according to which a finite angular momentum of the atomic core was the cause of this doublet structure—must be given up as incorrect. In the fall of 1924 I published some of my arguments (*Z. Phys.*, 1925, **31**, 373) that, instead of the angular momentum of the closed shells of the atomic core, a new quantum theoretic property of the electron had to be introduced which I called "a two-valuedness not describable classically." At this time a paper by the English physicist, Stoner, appeared (*Phil. Mag.*, 1924, **48**, 719), containing not only improvements in the classification of electrons in subgroups, but also the essential remark that the number of energy levels of a single electron in the alkali metal spectra for a given value of the principle quantum number in an external magnetic field is the same as the number of electrons in the closed shells of the rare gases which corresponds to this principal quantum number. On the basis of my earlier results on the classification of spectral terms in a strong magnetic field the general formulation of the exclusion principle became clear to me. The fundamental idea can be formulated in the following way: The complicated numbers of electrons in closed subgroups reduce to the simple number *one* if the division of the groups by giving the values of the 4 quantum numbers of an electron is carried so far that every degeneracy is removed. A single electron already occupies an entirely nondegenerate energy level. The exposition of this general formulation of the exclusion principle was made in Hamburg in the spring of 1925 (*Z. Phys.*, 1925, **31**, 765) after I was able to verify some additional conclusions during a visit to Tübingen, with the help of the spectroscopic material assembled there.

If one pictures by boxes the nondegenerate states of an electron in an atom, the exclusion principle maintains that a box can contain no more than one electron. This, for example, makes the atoms much larger than if many electrons could be contained in the innermost shell. Quantum theory maintains that other particles such as photons or light particles show opposite behavior; that is, as many as possible fill the same box. One can call particles obeying the exclusion principle the "antisocial" particles, while photons are "social." However, in both cases sociologists will envy the physicists on account of the simplifying assumption that all particles of the same type are exactly alike.

With the exception of experts on the classification of spectral terms, people found it difficult to understand the exclusion principle, since no meaning in terms of a model was given to the fourth degree of freedom of the electron. The gap was filled by Uhlenbeck and Goudsmit's idea of electron spin, which made it possible to understand the anomalous Zeeman effect. Since that time the exclusion principle has been closely connected with the idea of spin. Although at first I strongly doubted the correctness of this idea because of its classical mechanical character, I was finally converted to it by Thomas' calculations on the magnitude of doublet splitting. On the other hand, my earlier doubts as well as the cautious expression, "classically nondescribable two-valuedness," experienced a certain verification during later developments, as Bohr was able to show on the basis of wave mechanics that the electron spin cannot be measured by classically describable experiments (as, for instance, deflection of molecular beams in external electromagnetic fields) and must therefore be considered as an essentially quantum mechanical property of the electron.[1]

This is not the place to go into the details of the subsequent developments. On the one hand, the validity of the exclusion principle for all elementary particles of spin ½ was shown (for example, not only for electrons but also for neutrons and protons). This gave the principle a more general and universal meaning, and it found application to the problem, still not completely solved, of nuclear structure. On the other hand, the exclusion principle could not be deduced from the new quantum mechanics and wave mechanics, but remains an independent principle which excludes a class of mathematically possible solutions of the wave equation. This excess of mathematical possibilities of the present-day theory, as compared with reality, is in my opinion one of several indications that in the region where it touches on relativity theory, quantum theory has not yet found its final form.

The history of the exclusion principle is thus already an old one, but its conclusion has not yet been written. The essential advance of physics rests on the creative imagination of the experimental as well as the theoretical investigator, and, contrary to expensive applications of known principles, cannot be forced by planning on a grand scale. Therefore it is not possible to say beforehand where and when one can expect the further development of the basic principles of present-day physics, of which the problem of the exclusion principle is a part. We know, however, that this further development can take place only in the same atmosphere of free investigation and unhampered exchange of scientific results between nations that existed at the time of the disclosure of the exclusion principle. I am therefore very glad to be able to give this short historical survey here in Princeton's Institute for Advanced Study, which in the difficult years of the war, by support of pure and free research irrespective of applications, made it possible for me and others to continue our scientific work.

---

[1] See Rapport du Sixieme Conseil Solvey de Physique, Paris, 1932, pp. 217–225.

Introductory Remarks

Frank Aydelotte, *Director*
Institute for Advanced Study, Princeton, New Jersey

IT GIVES ME GREAT PLEASURE, ladies and gentlemen, to welcome you on behalf of the Trustees and Faculty of the Institute for Advanced Study on this happy occasion. The awarding of a Nobel Prize to a newly appointed member of our Faculty is just the kind of endorsement of our choice that we value and that we ought to expect. In one sense Pauli's is our fourth Nobel Prize: one member of our Faculty, Einstein; one former member of our Board of Trustees, Carrel; and one former member of the Institute, Rabi, have already received Nobel Prizes. That, however, is a little like the statement in the Believe-It-or-Not cartoon that Lindberg was the sixty-fourth person to fly across the Atlantic ocean. In a real sense Pauli is our first, just as Lindberg was the first to succeed in the design which he attempted.

About one-seventh of the 215 Nobel Prizes so far awarded have gone to citizens of the United States. In view of the size of our educational organization, that is not too many—indeed, it is not enough. We cannot yet claim Pauli's as an American achievement; the exclusion principle was formulated by him twenty years ago while he was still an Austrian. We hope that in a few weeks we shall have the pleasure of welcoming Dr. and Mrs. Pauli to American citizenship.

It is fitting that Pauli should become an American citizen and a member of the Faculty of the Institute for Advanced Study. American civilization, American scholarship, American art and letters, are products of the great European tradition. Our task is not to separate ourselves from that tradition but to support it and to enrich it by the productive work of American scholars. In these days when all men's minds in every field of endeavor are disturbed by the conflict between individualism and collectivism, we may be thankful for the fact that our scholarly tradition is one of individualism. The Nobel Prizes are one evidence of that philosophy. The organization of the Institute for Advanced Study is another. The fundamental plan of this institution is to provide opportunity for individual effort, not for what is called planned research. Our newspapers and magazines, even some scientific periodicals, are filled today with vast and nebulous schemes for the regimentation of scholars in the great war against chaos and ignorance. Useful work, like the production of the atomic bomb (if you call that useful), may be done by such organization. But the great advances of knowledge are not made by such means. They are, rather, the product of individual effort, free, unpredictable in their nature and in their consequences. They are the products of minds like Newton, Einstein and Pauli: "Voyaging through strange seas of thought alone."

Such a plan or, rather, lack of plan for the advancement of knowledge violates all the instincts and preconceptions of the adminstrative type of mind. It is not orderly, but, rather, haphazard. I can only say that the whole process of evolution on this planet has, so far as we can see, been an unexpected one. It may conform to some divine plan, but it does not follow any plan of human devising. There is nothing in the *Bible* about the exclusion principle or the atomic bomb, though the author of "Revelations" would doubtless have equipped the Four Horsemen of the Apocalypse with the latter device had he known about it.

Robert Louis Stevenson was once asked what was the moral to one of his stories. "My moral?" he replied, "I have no moral: it is God's moral that I am trying to understand." So with our scientists. It is nothing less than the mind of God they are seeking to penetrate.

All educational institutions, all societies of scholars, are devoted to this high quest. It is with this in mind that we have tried to make conditions here such that they can devote themselves to it in the single-minded way that is not always possible elsewhere. It is in line with our fundamental purpose that we have chosen Pauli to be a member of our Faculty. We hope that he will make his career here and that the exclusion principle will not be the last or the greatest of his contributions to physics.

Encomium

Hermann Weyl
Institute for Advanced Study, Princeton, New Jersey

IT IS DIFFICULT TO IMAGINE what the history of physics would have been without the influence of Pauli during the last twenty-odd years. As another Nobel laureate recently expressed it, "Pauli for many years has been the conscience and criterion of truth for a large part of the community of theoretical physicists." Thus, there is complete unanimity the world over that Pauli has amply deserved the recognition now accorded his work by the Royal Swedish Academy, to whose hands, by Nobel's will, the distribution of the Nobel Prize for Physics is entrusted. . . .

I think it is very fortunate that through the accident of Nobel's birth the lot to bestow this highest international honor for scientific achievement fell to Sweden, one of the Scandinavian countries. Indeed, these countries march in the vanguard of civilization; nowhere on this planet has man come nearer to the fulfillment of his dream of a happy and free life, with justice and equal opportunity for all, where good prevails over evil, and beauty and truth can shine and are loved. In physics and mathematics in particular the Scandinavian countries have, during the last decades, contributed more than their share to the advancement of our knowledge. It is enough to mention one name, that of Niels Bohr, who has exerted the most extraordinary influence upon the development of physics and on the whole generation of younger physicists in the last thirty years. Pauli himself is his disciple.

The impression prevails that it has been harder for a theoretical than for an experimental physicist to win the Nobel laurels. One obvious reason is that it is more difficult to assess at an early stage the importance of a theoretical discovery. When modern quantum physics came into being around 1925, one often spoke of it as boys' physics—"Knabenphysik." Indeed, at the time neither Heisenberg, nor Dirac, nor Pauli were over twenty-five (de Broglie and Schrödinger were somewhat older). It is gratifying that now all the boys who enacted this great scientific drama have been crowned by the Swedish Academy.

Born and educated in Vienna, Wolfgang Pauli started his scientific career in Munich under Arnold Sommerfeld. Perhaps I am among the first with whom he established scientific contacts, for the first papers he published dealt with a unified field theory of gravitation and electromagnetism which I had propounded in 1918. He dealt with it in a truly Paulinean fashion—namely, he dealt it a pernicious blow. Pauli's article on relativity theory, written in these years for the *Mathematical Encyclopaedia,* is a mature and masterly work which shows the author in full command of both the mathematical and physical aspects of the subject; and yet it was the work of a young man of twenty. After having earned his Ph.D. in Munich, Pauli migrated to Göttingen, since the time of Gauss a center of mathematical and physical research, where Max Born and James Franck were teaching at that time, and from there he went to Copenhagen and came under Niels Bohr's strong formative influence. From 1923 to 1928 he was *Dozent* at the University of Hamburg, and since then he has occupied a chair for theoretical physics at the Eidgenössische Technische Hochschule at Zürich. The year 1935–1936 he spent as a visiting professor at our Institute. In 1940, immediately after the invasion of Denmark and Norway by the Nazis, when it was clear that all the other neutral European countries were in danger of being overrun by the swastika, the Institute made an effort to bring Niels Bohr and Pauli to this country. Bohr considered it his patriotic duty to stay in Copenhagen, but we were lucky enough to get Pauli. I hope he does not regret that he came, even though Switzerland was spared the fate of being invaded by Hitler's hordes.

Let me now cast a quick glance over Pauli's principal achievements in physics—although a mathematician is hardly entitled to speak about them with authority. We mathematicians feel near to Pauli since he is distinguished among physicists by his highly developed organ for mathematics. Even so, he is a physicist; for he has to a high degree what makes the physicist: the genuine interest in the experimental facts in all their puzzling complexity. His accurate, instinctive estimate of the relative weight of relevant experimental facts has been an unfailing guide for him in his theoretical investigations. Pauli combines in an exemplary way physical insight and mathematical skill.

As I have already mentioned, Pauli began his work in the sign of relativity theory. Although he later returned to this theory on one or two occasions, his main work, by which he should be judged as a creative physicist, is in quantum physics. Here it is natural to distinguish the periods before and after the Heisenberg-Schrödinger break-through to a consistent quantum theory of the atom in 1925. In the time before this dramatic event one had to operate with Niels Bohr's models and a compromise that Bohr vaguely formulated as the Principle of Correspondence, and to find one's way through the maze of spectroscopic facts more by divination ("Schnauze" is Pauli's word for it) than by theory. It is remarkable that in this period Pauli scored some of his greatest successes. For instance, he saw that the so-called hyperfine structure of spectral lines is to be ascribed to a quantum character of the nucleus rather than to the electronic shell of the atom. But above all, his investigations concerning the Zeeman effect gradually led him to the discovery of the exclusion principle, according to which no two electrons may be in the same quantum state. This was a very bold conception. The exclusion principle, strange and incomprehensible as it is from the standpoint of classical physics, is decisive for an understanding of the periodic system of chemical elements. It is a lasting achievement, which will hardly be affected by any future changes of our physical theories.

One would expect that in stable equilibrium each electron revolving around the nucleus occupies the lowest possible energy level, according to the Planck-Bohr quantum rule. Instead, when we run over the chemical elements in their natural order, we find that only the first two electrons, in hydrogen and helium, are bound in this lowest state. Then a sort of saturation seems to be reached. The next element, lithium, has only one valence electron. As the spectra show, the eight electrons from lithium to neon are all bound in the next higher level, and with neon again a closed shell which can admit no further electrons, seems to have been completed. It is these fundamental facts which Pauli's exclusion principle explains. In developing it he had to overcome an accessory difficulty. When he started his work the quantum state of an electron was characterized by three quantum numbers. But that led to shells of 1, 4, 9 . . . electrons instead of 2, 8, 18 . . . , as we find in nature. He accounted for this "duplicity" by a fourth quantum number of the electron. Shortly afterward, Goudsmit and Uhlenbeck suggested that this quantum number had its origin in an angular momentum, a spin of the electron. Again it was Pauli who, once the foundations of the new quantum mechanics were established, first succeeded in describing correctly the nature of this momentum, which is radically different from that of a spinning top and not to be accounted for by classical concepts.

The Pauli principle reveals a general mysterious property of the electron, the importance of which is by no means limited to spectroscopy. Pauli himself applied it to the statistics of particles in a degenerate gas, thus explaining the paramagnetic properties of such gases. A paper on the paramagnetism of metals laid the foundations for the quantum mechanical theory of electrons in metals. A step of great consequences, for which Dirac's quantum theory of radiation had paved the way, was taken in a joint investigation by Pauli and Heisenberg on the quantization of the field equations: thereby wave mechanics passed from the theory of a single particle to that of the interaction of an indefinite number of particles. Pauli's studies of the intimate relationship between spin and statistical behavior of particles naturally led him to investigate the dynamics of the meson. The meson is now a generally accepted particle in nuclear physics. Of a more dubious character seems an invention of Pauli's, the most elusive of all elementary particles, which he dubbed neutrino, and others call Paulino. It is a particle without charge and mass, which nevertheless seems to be indispensable if the laws of conservation of energy and angular momentum are to be safeguarded. Here are question marks for the future.

My brief account is far from complete. I have not mentioned Pauli's two great articles on quantum theory, written for the *Handbuch der Physik* in 1925 and 1933. Enormous, but difficult to assess, is the influence Pauli has exerted by correspondence and discussion. In view of the discontinuous leaps by which theoretical physics develops, the stream of his scientific production has been remarkably steady. Indeed, when I compare the theoretical physicist with the mathematician I find that the former has a much harder lot. If the mathematician cannot solve a problem, he modifies it until he can solve it; no impenetrable reality limits the freedom of his imagination. So he is liable to succumb to Peer Gynt's temptation: " 'Go around,' said the crooked." Not so the physicist. He has to face the hard facts of nature. The problem of the atom must be solved straightforwardly; otherwise, no further progress is possible. Therefore, theoretical physics has affluent periods when, after persistent efforts, a new stage of theoretical interpretation has been reached, as was the case, for instance, in 1925; then there is all of a sudden plenty of highly satisfactory work for the theorist. But this alternates with stagnant periods where nothing else seems possible than to wait patiently for the slow accumulation of new facts by the experimentalists—facts which refuse to fall into any recognizable theoretical pattern. I have the greatest admiration for the courage and ingenuity with which Pauli has met this intriguing situation.

Another tension tells on the theoretical physicist—that between pure science and applications. He is a theorist and thereby committed to the contemplative life and its ideals. As Dilthey once said, "das vom Eigenleben unabhängige Glück des Sehens" is one of the most primitive and basic blessings of our existence. True, the physicist's contemplation is not a purely passive attitude—it is creative construction, but construction in symbols, resembling the creative work of the musician. On the other hand, science, since it discloses reality, is applicable to reality. Thus it is called upon to serve for the benefit and malefit of mankind. Its technical applications are used to make man's life more comfortable and more miserable, to build and to destroy. To what extent shall and can the theorist take responsibility for the practical consequences of his discoveries? What a beautiful theoretical edifice is quantum physics—and what a terrible thing is the atomic bomb! When they helped to develop the latter, did the physicists do nothing but their duty as citizens of a country engaged in total war, or did they prostitute their science? I think the experience of the last years has shown that there is little danger that the call of national duty will not be heeded by the scientists when the life of the nation is at stake, but that there is great danger indeed that in the fight for the basic values of our existence we may lose these values themselves; that the relentless pursuit of science—strange antinomy!—may imperil its very foundations in man's life. Pauli has all his life been deeply interested in philosophy. The wisdom of the Chinese sages seems to have a special appeal for him. No wonder that his sympathies are with those who are not willing to sacrifice the spiritual for the secular, and who are not willing to accept efficiency as the ultimate criterion. . . .

Scanning Science—

New honors are being bestowed upon the discoverers of argon. First came the Barnard gold medal of Columbia College, then the $10,000 Hodgkins prize, then the prize of 50,000 francs from the French Institute and now it is announced that Lord Rayleigh and Professor Ramsay have been made Knights of the Legion of Honor, by order of the French Government.

—14 February 1896

Technical Papers

The High Ascorbic Acid Content of the West Indian Cherry

CONRADO F. ASENJO and ANA ROSA FREIRE DE GUZMÁN
School of Tropical Medicine, San Juan, Puerto Rico

The West Indian cherry (*Malpighia punicifolia* L.), commonly called "acerola" in Spanish, is a small tree native to tropical and subtropical America. Its fruit is fleshy and drupaceous, bright red in color when ripe, and possessing an agreeably acid taste. Each of the cherries weighs about 5 grams; nearly 80 per cent of their weight is edible.

As far as we have been able to find out, the three richest natural sources of ascorbic acid known to date are the rose hips (*Rosa* sp.) (*4*), the "mirobalán" (*Phylanthus emblica* L.) (*3*), and the guava (*Psidium guajava* L.) (*5*). They contain about 1,700, 800, and 300 mg., respectively, of ascorbic acid per 100 grams of edible matter.

Utilizing the assay method of Bessey and King (*2*) (2,6-dichlorophenol indophenol titration), we found that the West Indian cherry contained within the high limits of 1,000–3,300 mg. of ascorbic acid per 100 grams of edible matter. The variation in its ascorbic acid content seems due principally to its degree of ripeness, the content being highest in the green fruit and lowest in the ripe.

TABLE 1

Degree of ripeness and color of fruit	No. of samples*	pH of juice	Range mg. ascorbic acid per 100 gram of edible matter	Average mg. ascorbic acid per 100 gram of edible matter
Unripe—green ...	4	3.35	2,516–3,809	2,968
Medium ripe—yellow green with red spots	3	3.35	2,481–3,048	2,787
Fully ripe—red ..	4	3.35	1,080–2,700	1,707

* Each sample consisted of at least 15 cherries.

To confirm fully the presence of ascorbic acid in the West Indian cherry, the acid was isolated from the juice by a method not materially different from that utilized by Banga and Szent-Gyorgyi (*1*) in their study of peppers. Briefly, it is as follows: The ascorbic acid is precipitated from the juice in the form of the lead salt on the addition of neutral lead acetate, followed by enough ammonium hydroxide to bring the pH to 8.3–8.5. The lead salt thus obtained is decomposed with concentrated HCl, the supernatant acid mixture then concentrated *in vacuo*, and the ascorbic acid, present therein, extracted with acetone. The acetone extracts are mixed wih *n*-butyl alcohol, and the acetone is evaporated *in vacuo*. Ascorbic acid remains in the *n*-butyl alcohol and crystallizes out of it, after standing at a temperature of 0° C. for three days.

A gram and a half of pure crystals was obtained out of 275 ml. of the juice. These crystals had a melting point of 191–192° C.; a mix melting point with synthetic *l*-ascorbic acid, 189–191° C. Equal weights of the synthetic and natural product decolorized, to the same extent, equal volumes of indophenol reagent. The specific rotation in water of the synthetic and the natural substances was also similar. It is quite apparent that the substance obtained from these cherries is pure *l*-ascorbic acid.

It would seem that the West Indian cherry is one of the richest, if not *the* richest, edible fruit source of ascorbic acid so far described in the literature.

References

1. BANGA, I., and SZENT-GYORGYI, A. *Biochem. J.*, 1934, **28**, 1625.
2. BESSEY, O. A., and KING, C. G. *J. biol. Chem.*, 1933, **103**, 687.
3. GIRI, K. V., and DOCTOR, N. S. *Ind. J. med. Res.*, 1938, **26**, 165.
4. HUNTER, G., and TUBA, J. *Canad. med. Ass. J.*, 1943, **48**, 80.
5. MUNSELL, H. E. *Food Res.*, 1945, **10**, 42.

Motherless Males From Irradiated Eggs[1]

ANNA R. WHITING
University of Pennsylvania

"Androgenesis" (*6*) was first demonstrated by Hertwig (*3*), who found that, when amphibian eggs are heavily irradiated and then fertilized by untreated sperm, abnormality in development is *inversely* proportional to intensity of treatment. Embryos from such eggs have nuclei smaller than normal, and these nuclei were thought to be haploid and descendants of the sperm nucleus. Packard (*4*) irradiated Chaetopterus eggs in first meiotic metaphase and obtained clear cytological proof that the untreated sperm nucleus in such eggs can form the first cleavage figure and its successors. Dalcq (*1*) checked Hertwig's results and added cytological proof of androgenesis in Amphibia.

It is uncertain whether androgenetic larvae in any of these experiments would develop into adults. As

---

[1] Aided by a grant from the Rockefeller Foundation.

Fankhauser (*2*) has pointed out, "In the thousands of experiments which have been performed up to the present time, not a single haploid animal has been raised to a stage approaching sexual maturity." He is referring, of course, to animals in which all individuals are normally diploid. Normal, mature, androgenetic haploids might be expected to occur in species with haploid males, such as bees or wasps. During many years of intensive breeding of the parasitic wasp *Habrobracon juglandis*, several hundred mosaic individuals have been found among which 11 only (*5*) have had regions which were unquestionably paternal in origin. Among the progeny from crosses of dominant females by recessive males (condition in which androgenetic males can be identified) only five males have been reported showing genetic traits exclusively paternal with no traces of mosaicism. None of these was given a breeding test. A sixth, with "glass" eyes, bred as "glass," showing the gonads to be derived from the sperm nucleus. Thirteen of these 17 individuals were produced by females of one stock, and none was found in crosses from the stocks used in this experiment. Spontaneous androgenesis is, therefore, very rare, even in a species with normal male haploidy.

In a recent experiment, unmated females of an inbred wild type stock of Habrobracon were heavily X-rayed,[2] then mated to untreated males with recessive mutant traits. The surviving progeny (from eggs treated in first meiotic prophase) included among the expected wild type males (haploid and maternal) and females (diploid and biparental) a few males normal in structure and behavior and with the recessive mutant traits (haploid and paternal). Breeding tests demonstrated that their gonads were also paternal in origin, and the use of body color differences helped to show that they were not mosaic. Their normal fertility was proof of their haploidy, since diploid males in this species are almost completely sterile. Table 1 summarizes the results.

The cytological phenomena underlying the production of these motherless males remain to be investigated. Two possibilities suggest themselves: (1) The irradiated maternal chromosomes may be retarded in movement and fail to reach the male pronucleus in time for first cleavage or, having reached it, are soon eliminated so that the haploid paternal chromosome complement forms the embryo. The observations of Packard and of Dalcq demonstrate this type of behavior. (2) The fusion nucleus may fail to function, hampered by its irradiated chromatin, and, when dispermy occurs, the free sperm may form the embryo.

In egg X-rayed with lethal dose (*ca.* 45,000 r) and allowed to develop parthenogenetically, about 11 per cent die at first cleavage, while the remainder develop well beyond this stage, often to blastoderm. In normal eggs about 1 per cent show dispermy. Either of these facts would seem to limit the production of androgenetic males to about 1 per cent, but survival percentages may not be dependable criteria of modes of origin because of differential viability.

TABLE 1

Dose in r units	Number females treated	Progeny			
		Wild type males	Wild type females	Recessive males	Per cent androgenesis
28,000	378	82	341	15	4.21
29,300	43	8	10	3	23.07
42,000	202	1	7	1	12.50
Controls ..	17	160	467	0	0.0

The production of these normal, sexually mature individuals from the sperm nucleus is of theoretical interest from two aspects. It adds evidence to a concept which now seems to need little—that hereditary traits are carried by the nucleus—and appears to strengthen the point of view that X-ray injury, at least up to lethal dose, is directly chromosomal, since untreated chromosomes can function normally in the heavily treated cytoplasm of an egg whose own chromosomes are so seriously injured as to be unable to function.

References

1. Dalcq, A. *C. R. Soc. Biol. Paris*, 1930, **104**, 1055–1058.
2. Fankhauser, G. *J. Hered.*, 1937, **28**, 2–15.
3. Hertwig, G. *Arch. mikr. Anat.*, 1911, **77**, 165–209.
4. Packard, C. *Biol. Bull.*, 1918, **35**, 50–67.
5. Whiting, P. W. *J. Hered.*, 1943, **34**, 355–366.
6. Wilson, E. B. *The cell in development and heredity.* (3rd ed.) New York: Macmillan, 1925.

---

[2] By L. R. Hyde at the Marine Biological Laboratory, Woods Hole, Massachusetts.

Diabetes Produced by Feeding Alloxan to Cats[1]

J. A. Ruben and K. Yardumian

The Montefiore Hospital, Pittsburgh, Pennsylvania

It is well established that diabetes may be experimentally induced in animals by *injection* of an appropriate amount of alloxan solution intravenously, intraperitoneally, intramuscularly, or subcutaneously. In studying the introduction of alloxan into the alimentary canal without subjecting the animal to the effect of an anesthetic or an operative procedure, we have discovered that diabetes can be produced by *feeding* alloxan to cats. Furthermore, in addition to the destructive effect on the beta cells of the pancreas, we have noticed injury to the adrenal cortex, the anterior lobe of the pituitary, the liver, and the kidneys.

Method. One part of alloxan was freshly mixed

---

[1] The authors wish to express their gratitude to Sidney M. Bergman for his interest in this work.

with five parts of a favorite food and offered to a cat that had fasted 24 hours. If it did not eat promptly, the food was taken away and the procedure repeated 12 or 24 hours later. Animals that would not eat at that time were not used for these experiments. It is essential that they eat all of the dose quickly (in about 5 or 10 minutes), since, if the food is eaten too slowly, the alloxan is diluted to below its cytotoxic level.

The dose varied from 0.5 to 1.0 gram/kg. and was higher for immature animals than for mature ones. Six to 12 hours after the alloxan meal, the animals were given milk, and the next day they were fed their usual diet of milk and fresh raw meat.

Results. Of the 14 cats that ate the food mixed with alloxan, two ate it too slowly, and one vomited some of the food. These three did not attain a diabetogenic concentration of alloxan and seemed unharmed by their experience. A fourth cat developed a complete anuria and died at the end of 72 hours.

The 10 cats that developed diabetes showed a marked albuminuria on the first day and had both albumin and sugar in the urine on the second day. In some animals the urine passed during the first 24 hours was of a bright red color, due to the excretion of murexide. Four of these cats showed upper respiratory irritation with sneezing and frothy mucus at the external nares. One had conjunctivitis, and one had blood in the stool on the sixth and seventh days.

The experiments were terminated to permit blood and tissue studies: 2 cats on the third day; 3 on the eighth day; and 1 each on the sixteenth, nineteenth, twenty-first, thirty-sixth, and sixty-fourth days. The average blood sugar of the five animals sacrificed on the third to the eighth day was 259 mg. per cent, and of the 5 cats sacrificed from the sixteenth to the sixty-fourth day it was 245 mg. per cent.

Specimens of the pancreas, adrenal, pituitary, liver, and kidney were taken and fixed in modified Bouin's solution. Sections were stained by the method of Gomori (*1*) and with hematoxylin and eosin.

Histopathology. In the animals sacrificed early, the pancreas showed pyknotic nuclei and fragmentation of the beta cells; later, some islets showed atrophy and hyalinization.

The adrenal cortex showed most of the injury to the cells in the fascicular layer. In cases exhibiting severe damage there were areas of focal necrosis and hyalinization. The medullary portion seemed to escape injury.

The anterior lobe of the pituitary showed damaged areas varying from hydropic degeneration with pyknotic nuclei to necrosis with hyalinization and cystic degeneration. There was no evidence of injury to the posterior lobe.

The liver exhibited changes varying from congestion of the sinusoids, with granular degeneration of the cytoplasm and chromatolysis of the nuclei, to small and large areas of necrosis and fatty degeneration, involving in some cases more than half the liver cells.

In the kidneys there was mild congestion to marked swelling of the glomerular tufts which in some cases obliterated the space between Bowman's capsule and the tuft. The epithelium of the convoluted tubules showed hydropic degeneration, necrosis, and desquamation into the lumen. The straight tubules frequently contained hyaline casts. This acute injury to the kidneys tended to recovery. No distinct kidney damage was observed in some of the animals allowed to live a longer time.

Discussion. In these feeding experiments the severity of the diabetes seemed to be modified by the damaging effect of alloxan upon the adrenal cortex and the anterior lobe of the pituitary. This has been found true in surgically induced diabetes (*3*), when the adrenals or pituitary are removed before total ablation of the pancreas, and in alloxan diabetes (*2*). It is for that reason, we think, that these animals did not need glucose to tide them over the hypoglycemic stage, or insulin for the hyperglycemia.

From the work of Tipson and Ruben (*4*) it appears probable that alloxan (or its reduction products) occurs normally in animal bodies. They obtained indications that it occurs in highest concentration in the liver, which may be the organ that changes it to a less toxic substance, e.g. urea.

When alloxan is introduced into the animal body via the alimentary canal, it reaches the liver first and in highest concentration. The ensuing destruction of liver cells results in impaired liver function, which may be the reason our animals have shown more adrenal, pituitary, and kidney damage than in experiments reported by others in which the drug was introduced parenterally.

References

1. Gomori, G. *Anat. Rec.*, 1939, 74, 489.
2. Kirschbaum, A., Wells, L. J., and Molander, D. *Proc. Soc. exp. Biol. Med.*, 1945, 58, 294.
3. Long, C. N. H., and Lukens, F. D. W. *J. exp. Med.*, 1936, 36, 465; Soskin, S. *Physiol. Rev.*, 1941, 21, 140.
4. Tipson, R. S., and Ruben, J. A. *Arch. Biochem.*, 1945, 8, 1.

Sex Hormonal Action and Chemical Constitution

F. W. Schueler

University of Chicago

The following communication presents a new hypothesis regarding the essential chemical and structural features sufficient for male and female sex hormonal activity as evidenced by comb growth in the capon and production of estrus in the ovariectomized rat.

In 1941 Giacomello and Bianchi (*8*), through crystallographic studies, revealed that estrone and diethylstilbestrol are molecules of identical length, 8.55 A. This fact has suggested a means of classifying all substances showing estrogenic activity if the hypothesis is made that an optimum distance (D) of 8.55 A. between the hydroxyl or keto groups in the estrogens is essential for maximum activity. Such an hypothesis gives a division of the estrogenic substances into four classes:

I. Substances in which the distance, D, is very nearly the optimum, 8.55 A. These substances show the highest estrogenic activity.

II. Substances in which the distance, D, is appreciably larger than 8.55 A. These substances show decreasing estrogenic activity in proportion to the deviation from the optimum distance, 8.55 A.

III. Substances in which the distance, D, is appreciably less than 8.55 A. These substances also show decreasing estrogenic activity in proportion to the deviation from the optimum distance, 8.55 A.

IV. Substances which have the proper distance, D, but possess no hydroxyl or keto groups.

TABLE 1

Group	Substance	Distance (A.)	Activity (R.U.)
I.	trans-4,4′-dihydroxy-α, β-diethylstilbene (*3*)	8.55	.3 γ
	trans-1,2-di-α-(4-hydroxynaphthyl)-1,2-diethylethylene (*2*)	8.56	<10 γ
	1-methyl-2-(4-hydroxyphenyl)-3,4-dihydro-6-hydroxynaphthylene (*10*)	8.56	.5 γ
	3,9-dihydroxy-5,6,11,12-tetrahydrochrysene* (*12*)	8.75	10 γ
II.	1,3-di-(4-hydroxyphenyl)-1,2-diethylpropane (*13*)	9.8	5 mg.
	1,4-di-(4-hydroxyphenyl)-2,3-diethylbutane (*1*)	12.0	inactive
	2,8-dihydroxy-5,6,11,12-tetrahydrochrysene (*4*)	9.45	150 γ
III.	trans-3,3′-dihydroxy-α, β-diethylstilbene (*9*)	7.7	less than 4,4′ analogue
	trans-2,2′-dihydroxy-α, β-diethylstilbene (*9*)	5.9	less than 3,3′ analogue
	p,p′-dihydroxydiphenylether (*6*)	8.0	100% estrus with 80 mg.
	p,p′-dihydroxydiphenyl (*6*)	7.1	100% estrus with 100 mg.
IV.	triphenylchloroethylene (*7*)	8.56	65 γ

* Number the chrysene ring as in *Chemical Abstracts.*

Examples of each of these classes are listed in Table 1 together with the calculated distances, D[1], and the biological activities of the compounds.

The high activity of the substance, triphenylchloroethylene, indicates the critical distance (D = 8.55 A.) to be the distance between two hydrogen bond-formers which may be –OH groups (keto groups reducible or enolizable to –OH) or simply hydrogen atoms that have been activated by the inductive effect. The inductive effect is enhanced by the insertion of a chlorine atom in this latter case. This hypothesis is further borne out by the following facts:

1. Hydroxy derivatives are always much more active estrogens than the corresponding keto analogues.
2. Ethers of the sex hormones decrease in activity in the order of difficulty of hydrolysis. Ethers and esters which are very stable to hydrolysis are inactive (*5*).
3. Triphenylchloroethylene is a more powerful estrogen than triphenylethylene. This may be accounted for by the fact that the parahydrogens of this latter compound become stronger hydrogen bond-formers when chlorine is substituted for the ethylenic hydrogen by the inductive effect.
4. Tetraphenylethylene and diphenylethane show no estrogenic response in 100-mg. doses in spayed rats, thus indicating the importance of the chlorine in producing a highly active compound (*6*).

Considerations similar to the above have led to an hypothesis basic to androgenic activity. All of these ideas are summarized in the following, together with certain experimental data and predictions that have been made.

A given substance may be estrogenic if it consists of a rather large, rigid, and inert molecular structure with two active hydrogen bond-forming groups (e.g. phenolic hydroxyl groups) located at an optimum distance of 8.55 A. from one another. In particular, the substance trans-p,p′dihydroxyazobenzene meets the requirements for an estrogen (*11*) and, in spite of its obvious chemical and physical differences from the natural and synthetic estrogens, shows definite estrogenic activity in dosages of from 10 to 15 mg. injected subcutaneously into spayed rats and in much smaller dosages when applied directly to the vagina.

If the active groups are at a distance of approximately 9–10 A. and are of somewhat weaker hydrogen bond-forming character (e.g. secondary alcoholic hydroxyl groups), then the substance may have androgenic activity. The prediction is made, upon the basis of this hypothesis, that certain nonsteroid substances will show male hormonal activity (e.g. the perhydro derivatives of trans-diethylstilbestrol and perhydro-2(p-hydroxyphenyl)-6-hydroxynaphthalene). It is also noted that the dosage required to produce an androgenic effect in rats by the most active androgens is vastly greater than the quantity of estrogen needed to produce estrus in the rat. This may be explained by the greater hydrogen bond-forming power of "estrogenic hydrogen" (which is usually due to phenolic –OH groups) as compared to the weaker hydrogen bond-forming power of the androgenic hydrogen (e.g. secondary alcoholic hydrogen).

---

[1] The distances were calculated by means of bond angle and distance values taken from L. Pauling, *Nature of the chemical bond.* Ithaca: Cornell Univ. Press, 1942.

References

1. Baker, B. R. *J. Amer. chem. Soc.*, 1943, **65**, 1572.
2. Campbell, N. R., and Chattaway, F. W. *Proc. roy. Soc.*, 1942, **B130**, 485.
3. Dodds, E. C. *Proc. roy. Soc.*, 1939, **B127**, 140.
4. Dodds, E. C., Goldberg, L., Lawson, W., and Robinson, R. *Nature, Lond.*, 1938, **141**, 247.
5. Dodds, E. C., Goldberg, L., Lawson, W., and Robinson, R. *Proc. roy. Soc.*, 1939, **B127**, 140; Cook, J. W., Dodds, E. C., Hewett, C. L., and Lawson, W. *Proc. roy. Soc.*, 1934, **114**, 272.
6. Dodds, E. C., and Lawson, W. *Proc. roy. Soc.*, 1938, **B125**, 222.
7. Emmens, C. W. *J. Endocrinol.*, 1942, **3**, 168.
8. Giacomello, G., and Bianchi, E. *Gaz. Chim. Ital.*, 1941, **71**, 667.
9. Linnell, W. H., and Shaikmakamud, H. S. *Quart. J. Pharm. Pharmacol.*, 1941, **14**, 259.
10. Mentzer, C., and Urbain, G. *C. R. Acad. Sci., Paris*, 1942, **215**, 554.
11. Robertson, J. M. *J. chem. Soc.*, 1939, 232.
12. Salzer, W. *Z. physiol. Chem.*, 1942, **242**, 89.
13. Stuart, A. H., and Tallman, R. C. *J. Amer. chem. Soc.*, 1943, **65**, 1570.

Effect of Altitude Anoxia in Provoking Relapse in Malaria

Clifton D. Howe, Capt., M.C., and Fratis L. Duff, Col., M.C.

AAF School of Aviation Medicine, Randolph Field, Texas

The opinion is widely held that anoxia tends to precipitate relapse in individuals with latent malaria (*1*). This view, founded on clinical observation over a period of many years, received additional support during World War II when, with the increase in both the incidence of malaria and air travel, relapses of malaria were observed to occur following aerial flight. Recently, Gajewski and Tatum (*2*), studying the phenomenon of relapse in avian malaria, succeeded in inducing relapse in from 2 to 7 days in all of more than 100 canaries with latent *P. cathermerium* infection by exposing the birds continuously to an oxygen tension of approximately 75 mm. Hg.

In the present study an attempt was made to induce relapse in human subjects using a short, yet moderately severe, anoxic assault such as might occur during high-altitude flight. Fifty overseas returnees from various Army Air Force installations who gave histories of two or more recent attacks of malaria were the subjects. They were exposed for 1 hour in a low-pressure chamber to a simulated altitude of 18,000 feet without supplementary oxygen (oxygen tension, approximately 80 mm. Hg.).

Since the subjects' statements were the sole source of information in obtaining data as to the number, circumstances, and dates of their previous attacks, it was not possible in all cases to separate reinfections from relapses; therefore, only the total number of previous attacks was recorded in each case. While the subjects were at the simulated altitude, continuous oximeter readings of oxyhemoglobin concentration in the blood were made. Thick blood smears were made immediately before and immediately after the chamber flight, and daily thick blood smears were made for 5 days thereafter. The subjects remained in the hospital under observation for a minimum of 6 days following the chamber flight, and at the time of hospital discharge were instructed to report subsequent relapses. All subjects, with the exception of one individual who had finished quinine treatment of his last relapse only 3 days before the chamber run, had discontinued atabrine or quinine administration 15 days or more prior to the anoxic episode.

The mean oximeter reading of the group was 76.4 per cent. None of the 50 subjects experienced relapses within 7 days of the chamber flight. Eight of the subjects, however, had relapses at periods varying from 8 to 35 days following the flight. None of the subjects included in the series had positive blood smears before entering the chamber or during the succeeding 5-day period when daily blood examinations were made. Data pertaining to the 8 subjects who relapsed subsequent to the 7-day period are shown in Table 1.

TABLE 1

Data on 8 Cases Which Relapsed Later Than 7 Days After the Anoxic Experience

Case No.	No. of previous attacks	Days since last attack	Days since last atabrine	Relapses		
				Days after chamber flight	Type	Days after last attack
3	7	25	17	8	Vivax	33
6	2	36	31	8	..*	42
8	6	12	3 (quinine)	23	..*	38
13	4	33	17	18	Vivax	51
42	9	26	15	30	..*	56
43	2	26	18	35	Vivax	61
44	5	52	46	17	Vivax	69
49	7	42	35	18	Vivax	60

* Type not reported.

In summary, neither relapse nor parasitemia was observed in a group of 50 individuals giving histories of recent malaria within a period of 7 days following exposure to the anoxia produced by a 1-hour stay at 18,000 feet in a low-pressure chamber.

References

1. Fairley, N. Hamilton. *Trans. Roy. Soc. trop. Med. Hyg.*, 1945, **38**, 342.
2. Gajewski, J. E., and Tatum, A. L. *J. infect. Dis.*, 1944, **74**, 85–92.

The Transmission of *Litomosoides Carinii,* Filariid Parasite of the Cotton Rat, by the Tropical Rat Mite, *Liponyssus bacoti* [1]

Roger W. Williams[2] and Harold W. Brown[3]

The authors recently reported (*2*) the development of *Litomosoides carinii,* filariid parasite of the cotton rat, *Sigmodon hispidus,* from the microfilarial to the infective stage in the tropical rat mite, *Liponyssus bacoti.* We now have experimental evidence that the tropical rat mite serves as a vector of this filariid.

Four albino rats, 30 days old, were used in the experiment. Two of these rats were placed in individual wire-mesh cages, each cage being placed in a separate box beside a similar cage containing an infected cotton rat. A colony of mites were developed on each of the two cotton rats in their respective boxes prior to the introduction of the albino rats. The position of the two cages in each of the two boxes was periodically interchanged so that the mites could more readily have access to the albino rats after having fed on the infected cotton rats. The other two albino rats, which were used as control animals, were placed together in a wire-mesh cage. This cage was placed in a box, which harbored no mites, beside a similar cage containing a cotton rat heavily infected with *L. carinii.* The position of the cages containing the control rats and the infected cotton rat were also interchanged periodically. All three boxes, the two with the mites and the one without mites, were kept in the same room.

The two albino rats subjected to contact with the mites were autopsied 42 and 44 days after being placed in the mite colonies with the infected cotton rats. The rat autopsied after 42 days contained seven *L. carinii* worms in the pleural cavity ranging in length from 1.165 to 12 mm., while the second rat contained two worms, one 9 mm. and the other 42 mm. in length. The control rats were negative when autopsied after 44 days.

The length of the infective stage within the mites was found to be from 800 to 1,000 μ. It is interesting to note that the smallest worm found in the pleural cavity of the infected albino rat was only 165 μ longer than the largest infective form found within the mites. This indicates that either the parasite reaches the pleural cavity soon after gaining entrance to the rat or that growth is very slow until the pleural cavity is reached. It is also of interest that a length of 42 mm. could be attained in 44 days or less.

In a similar experiment a cotton rat and an albino rat, which had been experimentally infected by the mite vector, exhibited microfilariae in their blood 80 days after exposure to infected mites. Epidemiological evidence indicated by naturally infected rats points to the possibility that rats may be infected and exhibit microfilariae as early as 50 to 60 days after exposure to infection.

Chandler (*1*) reported that at the Rice Institute an albino rat which had been housed with cotton rats infected with this filariid parasite was also found to be infected with this worm. The mode of infection was unknown.

Now that it is possible to infect rats readily in the laboratory, new fields of filariasis investigation are open. Immunological and prophylactic drug studies can be conducted, and age resistance of worms to various chemotherapeutic agents can be studied.

References

1. Chandler, A. C. *Proc. U. S. nat. Mus.,* 1931, **78** (Art. 23), 1–11.
2. Williams, R. W., and Brown, H. W. *Science,* 1945, **102,** 482–483.

---

[1] This study was made possible through the financial support of the John and Mary R. Markle Foundation.

[2] Lt. H(S), USNR, assigned for research in Filariasis to the School of Public Health of the Faculty of Medicine, Columbia University.

[3] Professor of parasitology, School of Public Health of the Faculty of Medicine, Columbia University.

Scanning Science—

The Eighth Annual Report of the Trustees of the Marine Biological Laboratory at Woods Hole has just been issued, and shows that the summer of 1895 was the most successful in the history of the Laboratory. At different times during the summer there were 63 investigators present, 42 of whom occupied special research rooms. At present 25 colleges subscribe for investigator's rooms, besides five societies, including the American Association for the Advancement of Science and the American Society of Naturalists.

—13 March 1896

Science Legislation

Text of the New Kilgore-Magnuson Bill

A bill to promote the progress of science and the useful arts, to secure the national defense, to advance the national health and welfare, and for other purposes.

DECLARATION OF POLICY

SEC. 2. The Congress hereby finds that a full development and application of the Nation's scientific and technical resources is essential for the national defense, national prosperity, and the national health and welfare. The Congress declares it to be the purpose of this Act among other things to provide support for scientific research and development, to enable young men and women of ability to receive scientific training, to promote the conservation and use of the natural resources of the Nation, to correlate the scientific research and development programs of the several Government agencies, to achieve a full dissemination of scientific and technical information to the public, and to foster the interchange of scientific and technical information in this country and abroad. The Congress finds it essential for these purposes to create a central scientific agency within the Federal Government.

NATIONAL SCIENCE FOUNDATION

SEC. 3. (a) There is hereby established an independent agency of the Federal Government to be known as the National Science Foundation (hereinafter referred to as the "Foundation"), and administered by an Administrator (hereinafter referred to as the "Administrator") who shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at the rate of $15,000 per annum. The President, before appointing an Administrator, shall consult with and receive the recommendations of the National Science Board created in section 4 (and hereinafter referred to as the "Board"). The Administrator shall appoint a Deputy Administrator, who shall perform the functions of the Administrator during his absence or when there is a vacancy in the office of the Administrator, and shall perform such other duties as may be delegated to him by the Administrator. The Deputy Administrator shall receive compensation at the rate of $12,000 per annum.

(b) There shall be within the Foundation a Division of Mathematical and Physical Sciences, a Division of Biological Sciences, a Division of Social Sciences, a Division of Health and Medical Sciences, a Division of National Defense, a Division of Engineering and Technology, a Division of Scientific Personnel and Education, a Division of Publications and Information, and such additional divisions, not to exceed three in number, as the Administrator may from time to time establish after receiving the advice of the Board. The functions of each division shall be prescribed by the Administrator after receiving the advice of the Board, except that until the Administrator and the Board have received general recommendations from the Division of Social Sciences regarding the support of research through that Division, support of social science research shall be limited to studies of the impact of scientific discovery on the general welfare and studies required in connection with other projects supported by the foundation. Each division shall be headed by a Director, who shall be appointed by the Administrator and shall receive compensation at the rate of $12,000 per annum.

(c) Except as provided in section 4, the Administrator shall appoint and fix the compensation of such personnel as he may deem necessary to carry out the provisions of this Act. Such appointments shall be made and such compensation shall be fixed in accordance with the provisions of the civil-service laws and regulations and the Classification Act of 1923, as amended, except that, when deemed necessary by the Administrator for the effective administration of this Act, expert scientific, technical, and professional personnel, including part-time personnel, may be employed without regard to the civil-service laws, and their compensation fixed without regard to the Classification Act of 1923, as amended.

NATIONAL SCIENCE BOARD AND DIVISIONAL SCIENTIFIC COMMITTEES

SEC. 4. (a) The Administrator, in exercising his authority under this Act, shall consult and advise with a National Science Board and, through the Directors of the several divisions, with divisional scientific committees, on all matters of major policy, program, or budget. The Board shall consist of nine members appointed by the President, by and with the advice and consent of the Senate, from among persons who are especially qualified to promote the broad objectives of this Act, plus the chairman of the several divisional scientific committees. The scientific committee for each division, except the Division of National Defense, shall consist of not less than five and not more than fifteen members appointed by the Administrator, with the advice and approval of the Board, except that the initial members of each such divisional scientific committee shall be appointed by the Administrator with the advice and approval of the Board members appointed by the President.

The scientific committee for the Division of National Defense shall consist of not more than forty persons, of whom at least half shall be civilians appointed by the Administrator, with the advice and approval of the Board, and the remaining members shall be divided equally between such chiefs of such services and divisions of the War Department and such chiefs of such bureaus and offices of the Navy Department as the Secretary of War and the Secretary of the Navy, respectively, may from time to time designate. There shall be within the divisional scientific committee for the Division of National Defense a five-man executive committee consisting of the chairman of the divisional scientific committee, as chairman; two civilian members elected annually by the civilian members of the divisional scientific committee; together with one Army officer, and one naval officer, each of whom should be charged in their respective Departments with the coordination of research, designated by the Secretary of War and the Secretary of the Navy, respectively.

Each divisional scientific committee shall be reasonably representative of the major scientific interests and functions of its division. Members of the Board appointed by the President and members of the divisional scientific committees appointed by the Administrator shall serve for three-year terms, except that (1) at least one-third of such members originally appointed shall be appointed for one-year terms, and at least another third for two-year terms, and (2) any member appointed to fill a vacancy occurring prior to the expiration of the term of his predecessor shall be appointed for the remainder of such term. No person thus appointed to serve as a member of the Board or any divisional scientific committee shall be eligible again to serve as a member of the same group until the expiration of one year after his term has expired, except that a member appointed for a term of less than three years may be appointed for a succeeding three-year term.

(b) The Board and each divisional scientific committee shall annually elect its own chairman from among its own members, and shall devise its own rules of procedure. The Board and each such committee shall meet at the call of its own chairman or at such times as may be fixed by itself, but not less than six times each year, including at least once each calendar quarter. Vacancies in the membership of the Board or of any divisional scientific committee shall not impair the authority of the remaining members to execute its functions, and a majority of the members of the Board or any divisional scientific committee as constituted at any given time shall constitute a quorum.

The Board shall appoint and prescribe the duties of an executive secretary of its own selection who shall receive compensation at a rate, not exceeding $12,000 per annum, to be fixed by the Board. The Administrator shall pay the compensation of such executive secretary and may furnish the Board and the divisional scientific committees such additional personnel, and such facilities, services, and supplies as may be necessary for the proper performance of the functions of the Board and the divisional scientific committees.

(c) The Board shall continuously survey the activities and management of the Foundation, and shall periodically evaluate the achievements of the Foundation in accomplishing the objectives of this Act. Each divisional scientific committee shall survey continuously the scientific field which it encompasses, shall undertake to determine the specific scientific needs of such field, and shall evaluate proposed programs and projects. The Board and each divisional scientific committee shall, upon its own initiative or upon request by the Administrator, make appropriate recommendations and reports relating to its duties and findings. The Board and each such committee shall have full access to all information in the possession of the Foundation.

(d) The Administrator shall render an annual report to the President and the Congress, summarizing the activities of the Foundation, together with such recommendations as he may deem appropriate. The Board shall annually and at such other times as it deems necessary, make such recommendations to the President and the Congress as in its opinion will further the objectives of this Act. The annual report shall include such independent recommendations concerning the budget, organization, and management of the Foundation, and such other recommendations as the Board and the divisional scientific committees may deem necessary to better effectuate the purposes of this Act. The annual report shall include whatever dissenting opinions may be submitted for that purpose by individual members of the Board or of the divisional scientific committees. The Administrator shall, whenever requested by the Board or any divisional scientific committee, publish and disseminate widely any recommendations or reports prepared by the Board or such committee.

(e) Members of the Board and of the divisional scientific committees shall receive compensation at the rate of $50 for each day engaged in the business of the Foundation, and shall be reimbursed for their necessary travel and other expenses incurred in the work of the Board or of any such committee. Persons holding other offices in the executive branch of the Federal Government may serve as members of the Board or any divisional scientific committee, but they shall not receive remuneration for their services as such members during any period for which they receive compensation for their services in such other offices, nor, except for representatives of the War and Navy Departments on the scientific committee for the Division of National Defense, shall they in their services as such members serve as representatives of the Government agency by which they are employed.

(f) Members of the Board and of any divisional scientific committee established under the provisions of this Act, and any other officers or employees of the Foundation, shall be chosen without regard to their political affiliations and solely on the basis of their demonstrated capacity to carry out the purposes of the Foundation and their fitness to perform the duties of their office.

(g) The Administrator may create such specialized additional advisory committees or employ the services of such advisory personnel as he may deem necessary to better effectuate the objectives of this Act. Persons so employed shall be reimbursed for their necessary travel and other expenses incurred in the work of the Foundation. Such persons may be noncompensated or may receive compensation at a rate not to exceed $50 for each day of service. Members of the Board and of the divisional scientific committees, and any other person serving in an advisory capacity, pursuant to this section, may serve as such without regard to the provision of sections 109 and 113 of the Criminal Code (18 U. S. C., secs. 198 and 203) or section 19 (e) of the Contract Settlement Act of 1944, except insofar as such sections may prohibit any such person from receiving compensation in respect of any particular matter which directly involves the Foundation or in which the Foundation is directly interested.

SUPPORT OF RESEARCH AND DEVELOPMENT

SEC. 5. (a) The Administrator is authorized to enter into contracts or other arrangements pursuant to which he will finance, in whole or in part, or otherwise support, research and development activities to be carried on by other Government agencies or by other organizations.

(b) Of the funds appropriated to the Foundation for research and development activities, not less than 15 per centum shall be available only for expenditure for research and development, pursuant to contracts or other financial arrangements made by the Administrator under this section, including contracts or arrangements to which subsection (c) is applicable, in each of the following fields: (1) National defense and (2) health and the medical sciences.

(c) Of the funds appropriated to the Foundation for research and development activities (excluding funds expressly appropriated for national defense), not less than 25 per centum shall be apportioned among the States as follows: Two-fifths shall be apportioned among the States in equal shares, and the remainder shall be apportioned among the States in the proportion that their respective populations bear to the population of all the States, determined according to the last preceding decennial census; and the amounts so apportioned to each State shall be expended only for carrying on research and development activities in the facilities of tax-supported colleges and universities, including the land-grant colleges, within such State pursuant to contracts or other financial arrangements made by the Administrator under this section. In making such contracts or other financial arrangements, the Administrator shall give each individual institution the widest latitude in its selection of individual research and development projects, but the Administrator shall not be required to expend funds in any institution unless it submits proposals for the expenditure of such funds which the Administrator finds to be consistent with such general program and standards as he may, after receiving the advice of the Board, establish in order to carry out the objectives and provisions of this Act. For purposes of this section the term "State" includes Alaska, Hawaii, and Puerto Rico. Of the funds appropriated to the Foundation for research and development activities (excluding funds expressly appropriated for national defense), an additional amount of not less than 25 per centum shall be expended in the facilities of nonprofit organizations without regard to the above limitations relating to State quotas or the tax-supported character of the organization. In meeting the requirements of this subsection, the Administrator may take into account whatever funds may be expended by the Foundation for facilities to be operated by the land-grant, tax-supported, or other nonprofit organizations, even though the title or ownership rights of such facilities remain with the United States.

(d) The activities of the Foundation shall be construed as supplementing and not superseding, curtailing, or limiting any of the functions or activities of other Government agencies authorized to engage in scientific research and development. Funds allocated by the Administrator to other Government agencies shall be utilized for projects approved by the Administrator and undertaken on behalf of the Foundation, and shall be in addition to, and not in lieu of, funds regularly appropriated to such other Government agencies.

(e) In all research and development activities financed or otherwise supported by the Foundation, the Administrator shall make every effort to eliminate restraints upon the free expression of scientific views and to insure full freedom in the exercise of creative talents, in the development of new ideas, and in the methods of research. Any person engaged in such research and development activities shall not be precluded from independently discussing, writing, or publishing his own views and conclusions relating to such research and development.

Scholarships and Fellowships

Sec. 6. The Administrator is authorized to award scholarships and fellowships to persons for scientific study or scientific work in any field of science, including but not limited to the mathematical, physical, biological, medical, and social sciences at nonprofit institutions of higher education, or other institutions, selected by the recipient of such aid, for such periods as the Administrator may determine, in the United States or in foreign countries. Persons shall be selected for such scholarships and fellowships solely on the basis of aptitude, within the limits of such quotas as may be established to insure an equitable selection of such persons from among the States and territories. Persons selected for such scholarships and fellowships may include employees of the Federal Government and such employees selected and detailed for scientific study or training shall not lose their status or seniority ratings for reason of absence from regularly assigned duties during the course of such study or training.

Register of Scientific Personnel

Sec. 7. The Administrator shall maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information concerning all scientific and technical personnel in the United States and its possessions. No individual shall be listed in such register without his consent.

Use and Dissemination of Research Findings

Sec. 8. (a) The Administrator shall make and maintain an inventory of all current federally financed research and development projects. In cooperation with the Commissioner of Patents, the Administrator shall establish a central register of all inventions, discoveries, patents, patent rights, and findings, including references to related data, in which the United States or any agency thereof has any right, title, or interest, or which pursuant to this section have been freely dedicated to the public. The Administrator shall record, collect, index, and promptly publish or cause to be published significant data on all inventions and discoveries and other findings produced in the course of federally financed research and development activities, or arrange with other Government agencies for such publishing, recording, collecting, and indexing. In consultation and collaboration with the Library of Congress and other Government agencies, the Administrator shall take such steps as he may deem necessary to make such information and other available significant scientific and technical information accessible to the public, including the preparation and distribution of reports, periodic catalogs, inventories, abstracts, translations, bibliographies, and microfilm and other reproductions thereof; and for such purposes the Administrator may utilize the facilities of Government agencies and other organizations to the extent that he deems necessary or desirable, and may contract for the expenditure of funds for such purposes without regard to the provisions of section 87 of the Act of January 12, 1895 (28 Stat. 622), and section 11 of the Act of March 1, 1919 (40 Stat. 1270) (U. S. C., title 44, sec. 111).

(b) Each contract or other arrangement for federally financed research or development entered into between any Government agency and any organization shall provide that such organization will make available to such agency full data on all inventions, discoveries, patents, patent rights, and findings produced in the course of such research or development, including such reports with respect thereto as may be required by such agency. Each Government agency, upon the request of the Administrator, shall make available to him such data and such reports with respect to research and development activities financed by such agency, as may be necessary for the purposes of this section.

(c) All inventions, discoveries, or findings in which the United States (or any Government agency), now or hereafter, hold any rights, including patent rights, shall be made available to the public on a nonexclusive and on a royalty-free basis to the extent the United States or such agency is entitled to do so under the rights held by it. Except as provided hereafter in this subsection and in subsection (d), any invention, discovery, or finding hereafter produced in the course of federally financed research and development shall, whether or not patented, be made freely available to the public and shall, if patented, be freely dedicated to the public. The requirements of this subsection, to the extent that they require modification of contracts or other financial arrangements already entered into by the United States (or any Government agency) shall not go into effect until one hundred and twenty days after the date of enactment of this Act.

(d) The head of any Government agency financing by contract, or otherwise administering, federally financed research and development activities, may, by stipulation in the contract or by other advance agreements with any organization, provide for the retention by the organization, or by the inventor, or by their assignees of such patent rights based on discoveries, inventions, or findings produced in the course of such research and development as the head of such Government agency deems fair and equitable, and consistent with the national interest: *Provided,* That (1) the head of such Government agency shall, before entering into any such contract or agreement, make a finding that the agency has made every reasonable effort to arrange for the conduct of the necessary research and development without entering into a contract containing such provision; (2) the organization shall contribute or shall have contributed substantially to the development of the particular inventions, discoveries, or findings for which patent rights are retained through earlier or current research and development activities financed by the organization; (3) in every case, the contract or agreement shall provide for at least an irrevocable, nonexclusive, royalty-free license for governmental purposes to the United States; and (4), in the case of any nonprofit organization, the head of such Government agency further determines (A) that the research and development is essential in the field of national defense or in such other fields as the President may specify for such purpose and (B) that the patent rights retained will not be used to serve the special benefit of any organization conducted for profit or of any individual, and will be made available or licensed to applicants on a nonexclusive, uniform, and reasonable royalty basis.

In the administration of the provisions of this subsection, the head of any Government agency shall be guided by such rules and regulations as the President may deem necessary and prescribe by Executive order.

(e) The Administrator shall make a quarterly report to the President and to the Congress concerning contracts and agreements containing the provisions authorized by subsection (d). This report shall include a list of all contracts and agreements containing such a provision entered into by any Government agency during the preceding quarter, the reasons supporting the approval of such provision in each case, the amount of Federal funds expended or to be expended under each contract or agreement containing such a provision, the name of the organization with which the contract or agreement was made, and the general nature of the patent rights reserved for private use in each case. The report shall also include a list of all inventions, discoveries, or findings in which patent rights were permitted to be retained pursuant to the provisions of subsection (d) and which were first recorded or finally authorized during the preceding quarter, identification of the contract or agreement under which such inventions, discoveries, or findings were produced, and the nature of the rights retained. The report shall also include the Administrator's recommendations, if any, for such further Executive or legislative action as he may deem necessary.

(f) Notwithstanding any other provision of this Act, the President, or any person designated for that purpose by him, may exempt from the provisions of this Act relating to dedication to the public, publication, dissemination, or making available, any scientific or technical information, data, patents, inventions, or discoveries produced in the course of federally financed research or development or in which the United States holds any rights, if and so long as the President or such designated person determines that such exemption is essential in the interest of national security.

INTERNATIONAL COOPERATION

SEC. 9. (a) The head of any Government agency is hereby authorized, with the approval of the President and through the Department of State, to conclude reciprocal agreements with foreign governments or agencies thereof, relating to the interchange of scientific and technological information (including models and samples for information purposes), and the use and availability of patents and patent rights owned or controlled by the respective governments.

(b) The Administrator is hereby authorized, with the approval of the President and through the Department of State, to cooperate in any international research or development activities consistent with the purposes or provisions of this Act and to expend for such international research activities such sums within the limit of appropriated funds as the Administrator may deem desirable.

(c) The Administrator may defray the expenses of representatives of Government agencies and other organizations and of individual scientists to accredited international scientific congresses and meetings whenever he deems it necessary in the promotion of the objectives of this Act.

INTERDEPARTMENTAL COORDINATION

SEC. 10. (a) There is hereby established an Interdepartmental Committee on Science, to consist of the Administrator, as Chairman, and the heads (or their designees) of such Government agencies engaged in or concerned with the support of scientific activity to a substantial degree as the President may from time to time determine. The Interdepartmental Committee shall meet whenever the Chairman so determines, but not less than once a month.

(b) The Interdepartmental Committee shall advise and assist the Administrator in gathering and correlating data relating to the scientific research and development activities of the Federal Government; shall study and evaluate such data in relation to the program of the Foundation and the scientific research and development programs of the other Government agencies; and shall make such recommendations to the Foundation and other Government agencies as in the opinion of the Committee will serve to aid in effectuating the objectives of this Act and other legislation providing for Federal support of scientific research and development. The Administrator, in consultation with the Interdepartmental Committee, shall, from time to time, make recommendations to the President for the achievement of maximum effectiveness in the conduct of all federally financed research and development.

MISCELLANEOUS

SEC. 11. (a) To enable the Administrator to carry out his powers and duties, there is hereby authorized to be appropriated annually to the Foundation, out of any money in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this Act. The funds appropriated to the Foundation, as herein authorized, and funds hereafter appropriated to any Government agency for scientific research or development, as herein defined, shall, if obligated during the fiscal year for which appropriated, remain available for expenditure for four years following the expiration of the fiscal year for which appropriated. After such a four-year period, the unexpended balances of appropriations shall be carried to the surplus fund and covered into the Treasury.

(b) The materials or equipment purchased by Federal funds or furnished by the Federal Government in connection with research and development activities shall be the property of the United States. The Administrator shall not, however, through the Foundation or its own employees, operate any laboratories, pilot plants, or other such scientific or technical facilities which he may acquire.

(c) In carrying out his functions under this Act, the Administrator is authorized—

(1) to prescribe such rules and regulations as he may deem necessary to govern the manner of the operations of the Foundation and its organization and personnel;

(2) to make such expenditures as may be necessary for carrying out the provisions of the Act;

(3) to enter into contracts, or amendments or modifications of contracts, without performance or other bonds, and without regard to section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) in the case of all contracts which relate to scientific research or development;

(4) to make advance, progress, and other payments which relate to scientific research or development without regard to the provisions of section 3648 of the Revised Statutes (U. S. C., title 31, sec. 529);

(5) to acquire by purchase, or otherwise, hold and dispose of by sale, lease, loan, or otherwise, real and personal property of all kinds necessary for, or resulting from, scientific research or development; and

(6) to prescribe, with the approval of the Comptroller General of the United States, the extent to which vouchers for funds expended under contracts for scientific research and development shall be subject to itemization or substantiation prior to payment, without regard to the limitations of other laws relating to the expenditure of public funds and accounting therefor.

(d) The provision of the Reorganization Act of 1945 shall be applicable with respect to the Foundation, and with respect to the transfer of agencies and functions to and from the Foundation, without regard to the provisions of section 5 (e) of such Act.

(e) The Office of Scientific Research and Development, and its constituent committees shall be transferred to the Foundation; together with such of the powers, functions, duties, personnel, property, records, funds (including all unexpended balances of appropriations, allocations, or other funds now available), contracts, assets, and liabilities as may be determined by the President. The National Roster of Scientific and Specialized Personnel shall be transferred from the Department of Labor to the Foundation, together with such of the personnel, records, property, and balances of appropriations as have been utilized or are available for use in the administration of such roster as may be determined by the President. The transfers provided for in this subsection shall take effect at such time or times as the President shall direct.

(f) If any provision of this Act, or the application of such provision to any person or circumstance, is held invalid, the remainder of this Act, or the application of such provision to persons or circumstances other than those as to which it is held invalid, shall not be affected thereby.

(*Continued on p. 240*)

Association Affairs

Housing Arrangements in St. Louis

St. Louis promises to be an ideal place for the first large-scale convention held by the AAAS for the past four years. Its hotels will provide 54 meeting rooms, while the St. Louis Municipal Auditorium or Kiel Memorial, engaged for the Association's exhibitions, will furnish an additional 16 meeting halls, 12 of which have a seating capacity of 250 or more.

Even so, our tentative program shows that as many as 40 to 60 meetings may be in progress at one time, and since most of these consist of groups of 100 or more, the necessity of housing the sessions of some societies apart from their headquarters hotel is apparent. This is even more true this year than in prewar years.

Reservations for sleeping quarters in St. Louis should be arranged through the Housing Bureau, 910 Syndicate Trust Building, St. Louis 1, Missouri, and must be made not later than 17 March. Requests for rooms to be occupied by two or more are more likely to be honored than those for single rooms.

Even with the best cooperation between the membership and the Housing Bureau, it is clear at this time that sleeping quarters in hotels are going to be completely inadequate. Every agency is now being used to track down every available room in private residences. These rooms will be comfortable, but not distinguished—they will be in homes whose families have on other occasions "rented a room for a night" to tourists or to conventioneers. When these resources are exhausted there will still be an acute room shortage. The officers and the committee on local arrangements need to have access to the homes of professional people where under ordinary circumstances to rent an extra room would be an unheard of practice. This note is a direct appeal to the membership and their friends in and around St. Louis to open their homes to their colleagues from out of town. In cases where it is possible at all, a person going to St. Louis for the meetings should make his own arrangements.

News and Notes

Dr. Morris B. Jacobs, senior chemist, Department of Health of the City of New York, has been designated chief of the Chemical Laboratory of the Department of Health.

Dr. Elmer L. Sevringhaus, professor of medicine at the University of Wisconsin, has accepted an appointment as director of clinical research for Hoffman-La Roche, Inc., and will assume his new post on 15 March at the laboratories in Nutley, New Jersey. The research and clinical program in endocrine, metabolic, and nutritional problems at the Wisconsin General Hospital will be carried on by Dr. Edgar S. Gordon, who has been associated with Dr. Sevringhaus for several years and who returned from military duty in January 1946.

Dr. Victor T. Allen has been appointed director of the Department of Geology at Saint Louis University. He has been on wartime leave of absence from his position as professor of geology at Saint Louis University since 1942, serving as commodity geologist for clay minerals in the U. S. Geological Survey. He will take over his new duties at the beginning of the first summer session on 13 May 1946.

Joseph A. Volk, radio engineer and graduate of the Technical University of Stuttgart, Germany, has been appointed instructor in engineering in the Institute of Geophysical Technology of Saint Louis University.

Dr. Howard de Forest, professor of botany at the University of Southern California for the past 23 years, retired in November 1945. Dr. de Forest is president of the chapter of Sigma Xi at the University for 1945–1946.

Dr. Harrison Davies, appearing before the Senate Committee on the control of atomic energy on 28 January, representing the Federation of Atomic Scientists, took the position that military men should not hold policy-making positions on any board or control commission. He said that it was "in the best tradition" of American Government that policy be set by civilians. "A subject fraught with such tremendous significance to our foreign policy as the development of atomic energy in this country must certainly be freed from every vestige of military control."

Dr. Woodrow W. Middlekauff, Cornell University, has recently been appointed assistant professor of entomology and assistant entomologist in the Agricultural Experiment Station, Division of Entomology and Parasitology, University of California, Berkeley. Dr. Middlekauff has recently left the army.

Professor Charles C. Grove, of the CCNY Mathematics Department, retired on 1 February after 25 years of service.

Capt. Alexander B. Klots, Sn.C., assistant professor of biology, College of the City of New York, delivered an address on 14 January on "Aeroplane Spraying and the New Uses of DDT" to the staff of the Servicio Especial de Saude Publico in Belem, Para, Brazil.

Dr. Hallowell Davis, associate professor of physiology at Harvard Medical School, will join the staff of Central Institute for the Deaf, St. Louis, as director of research. In collaboration with other members of the staff he will direct the expansion of the research and clinical program dealing with all phases of deafness, hearing, and speech defects.

Lt. Col. Francis E. Colien, Sn.C., who has served as executive officer, chief of Laboratory Service, and medical inspector, will resume his duties as associate professor of bacteriology and public health and preventive medicine at Creighton University School of Medicine and as director of laboratories, City Health Department, Omaha, Nebraska.

Dr. James N. DeLamater has recently been appointed assistant professor of tropical medicine and parasitology in the School of Medicine of the University of Southern California. Before joining the staff of the University Dr. DeLamater was executive officer of the Department of Epidemiology at the Naval Medical School, Bethesda, Maryland.

Dr. Eric T. B. Gross has been appointed professor of electric power system engineering at Illinois Institute of Technology.

Announcements

Mr. C. N. Davies, of the Industrial Health Research Board, London School of Hygiene, has reported an observation to *Nature* (1945, **156**, 666) which will be of interest to readers in the United States:

> In his book "Essays on the Floating-Matter of the Air" (1881), the physicist John Tyndall describes experiments which he carried out in 1876 refuting the doctrine of spontaneous generation of life. In the course of these experiments tubes of organic infusions were infected with organisms after exposure to the atmosphere. A number of cases occurred when such tubes, which were turbid and swarming with bacteria, became covered with *Penicillium glaucum*, three unspecified kinds being noticed. The bacteria in these tubes lost their translatory power and fell to the bottom, leaving the liquid between them and the superficial layer clear. Tyndall ascribes this to the success of the moulds in the struggle for existence and notes that access of oxygen to the body of fluid must have been hindered. He did not, however, test the clear liquid for its capacity to support newly implanted bacterial life. It is interesting to speculate upon what the consequences might have been had Tyndall allowed himself to be drawn from his main investigation.

Radio amateurs have made contacts over a range of 31 miles in the first use of super-high-frequency microwave bands outside the military and commercial tests.

A. E. Harrison, W6BMS, and Reuben Merchant, W2LGF, both of the Sperry Corporation, New York, using the 5,250- to 5,650-megacycle band, made contact at 5 miles and later reached 31 miles.

Microwaves, used in wartime radar, are found in super-high frequencies that have not been open to amateur radio operators before. Limited in distance, microwave beams are narrower than ordinary waves and permit use of smaller antennae and directional equipment not practical at lower frequencies—*Science Service.*

The Givaudan-Delawanna Corporation has granted to Dr. P. B. Price, professor of surgery, University of Utah, $5,250 for the investigation of skin disinfection.

The Armored Medical Research Laboratory, Fort Knox, Kentucky, is being reorganized by Col. Conn L. Milburn, Jr., MC, utilizing primarily civilian instead of military personnel. Tentatively the Laboratory is planning to continue its basic investigations into the physiological relationships of man to his environment and to the equipment that he uses in warfare. Somewhat greater emphasis will be placed on certain psychological aspects of these problems than was previously possible. Individuals interested in research work pertaining to the fields of biochemistry, physics, physiology, and psychology should write to Col. Milburn, Armored Medical Research Laboratory, Fort Knox, Kentucky.

Sixty-five members of the scientific faculty of Rutgers University have addressed a petition to President Truman and their Congressional representatives urging international control of atomic energy and free interchange of scientific ideas. The Rutgers faculty members stated their belief that the security of the United States can be achieved only through international cooperation for the joint control of atomic energy and atomic weapons. "We believe," their petition said, "that a policy of secret research and exclusive national control can only result in a ruinous competitive armaments race in which all the nations of the world will join, leading to the danger of a new and catastrophic world war. From such a war no people will emerge free, if indeed, they survive at all." They urged that the United States immediately invite Great Britain and the Soviet Union to a conference to prevent competitive armaments and to take up the problems arising from the development of atomic energy.

Stating further their belief that any legislation which stifles free and open scientific investigation and public surveillance and criticism of the application of atomic energy will hamper scientific progress, undermine peace, and thereby harm the national interest, the petitioners urged Congressional action to prevent it. They further urged that "security regulations be limited to direct military application of atomic power and that free research and right of publication be immediately resumed in the field of atomic physics."

Elections

The Rochester Academy of Science announces the following officers for 1946: Dr. Sherman C. Bishop, Department of Biology, University of Rochester, president; Dr. Gordon M. Meade, Medical School, University of Rochester, vice-president; Milroy N. Stewart, 172 Roosevelt Road, Rochester 10, secretary; William S. Cornwell, 109 Titus Avenue, Rochester 5, treasurer; and Mrs. David E. Jensen, Pittsford, New York, corresponding secretary. The Section chairmen are: Botany, Dr. Grace A. B. Carter, 30 Vassar Street, Rochester 7; Mineralogy, Robert C. Vance, Pittsford; Photography, H. Lou Gibson, 5274 St. Paul Street, Rochester 12; Astronomy, Paul W. Stevens, 2322 Westfall Road, Rochester, 10; Meteorology, Emil Raab, U. S. Weather Bureau, Municipal Airport, Rochester 11.

W. W. Horner, St. Louis consulting engineer was elected president of the American Society of Civil Engineers for 1946. The new vice-presidents are Arthur W. Harrington, district engineer, U. S. Geological Survey, Albany, and J. T. L. McNew, vice-president of Agricultural and Mechanical College, Texas.

Dr. Louis B. Howard, assistant chief of the U. S. Bureau of Agricultural and Industrial Chemistry, has been elected chairman of the California Section of the American Chemical Society.

Dr. M. Rocha e Silva has been elected president of the São Paulo branch of the Brazilian Biological Society, for the period January–December 1946. Dr. Rocha e Silva is head of the Department of Biochemistry and Pharmacodynamics at the Biological Institute of São Paulo.

The Genetics Society of America has elected the following officers for 1946: Dr. G. W. Beadle, president; Dr. Karl Sax, vice-president. Dr. L. H. Snyder is serving the third year of a three-year term as secretary-treasurer.

The Society of American Bacteriologists announces the election of the following officers to serve in 1946: Dr. James Craigie, Toronto, president; Dr. Thomas Francis, Jr., Ann Arbor, vice-president; Dr. Leland W. Parr, Washington, D. C., secretary-treasurer; Dr. M. J. Rosenau, Chapel Hill, and Dr. Frederick Smith, Montreal, councilors.

The Emory University Chapter of the Society of Sigma Xi has elected the following as officers for 1946: Dr. Evangeline Papageorge, president; Dr. W. B. Redmond, vice-president; Dr. L. W. Blitch, treasurer; Dr. A. C. Munyan, custodian; and Dr. R. T. Lagemann, secretary.

The Philosophical Society of Washington has announced the following officers for 1946: Francis M. Defandorf, president; Fred L. Mohler and Walter Ramberg, vice-presidents; Francis E. Johnston, corresponding secretary; Kenneth L. Sherman, recording secretary; and Frank C. Kracek, treasurer. On 5 January, George Ray Wait, retiring president, addressed the 1258th meeting of the Society on "Some Experiments Relating to the Electrical Conductivity of the Lower Atmosphere."

The Western Society of Naturalists held its Fifteenth Annual Winter Meeting at Mills College, Oakland, California, on 27–29 December. The following officers were elected for 1946: Laurence M. Klauber, Natural History Museum, San Diego, president; Gordon F. Ferris, Stanford University, vice-president; Herbert W. Graham, Mills College, secretary-treasurer; Boris Krichesky, University of California at Los Angeles, and Herbert L. Mason, University of California, Berkeley, members at large on the Executive Committee.

Meetings

The Southwestern Allergy Forum will meet in Houston, Texas, on 8–9 April under the chairmanship of Dr. Owen, Jackson, Mississippi. Dean C. D. Leake, University of Texas Medical Branch, Galveston, will address the evening meeting on 8 April on the subject: "Drugs in Allergy."

The 1946 annual meeting of the American Leather Chemists Association is scheduled to be held at the Hotel Sagamore, Lake George, on 19–21 June.

Conditions Abroad

Dr. N. Voronikhin (Woronichin), of the Komarov Botanical Institute, Academy of Sciences, writes to Dr. William Randolph Taylor: "I and my comrades in the same specialty, except Dr. A. Elenkin, who died, are in good health and are working successfully. The Department of Sporogenous Plants of our Institute, including the phycological collections, are in splendid shape." Dr. Voronikhin has published extensively on freshwater algae. The late Dr. Elenkin was a foremost authority on the myxophycean algae.

Dr. Gregorio Velasques, of the University of the Philippines, writes to Dr. William Randolph Taylor that the Department of Botany is resuming its work under the greatest difficulties but is making progress and is anxious to resume the marine algal survey of the islands begun before the war in conjunction with the University of Michigan. Dr. Eduardo Quisumbing, chief of the Natural History Museum, offers cooperation also. He reports the loss of Dr. José B. Juliano, a plant cytologist, during the war.

Dr. Julius Zweibaum, professor of histology at the University of Warsaw, Poland, has communicated recently with Dr. Ludwik Anigstein, of the University of Texas School of Medicine. After being arrested by the Gestapo and having escaped from jail, he was confined to the Warsaw ghetto, where he was wounded during the uprising and rescued from the ruins. With astonishing energy and determination Prof. Zweibaum is now rebuilding the Department of Histology, which has been completely destroyed by the Germans. All the laboratory equipment as well as the library have perished. There is an urgent need for microscopes, microtomes, incubators, glassware, and reagents. In view of complete lack of textbooks, J. Zweibaum is writing a new manual of histology. He is seriously handicapped by the lack of literature, a fountain pen, and typewriter.

L. B. Uichanco, dean, University of the Philippines College of Agriculture, Los Banos, Laguna, Philippines, has written to Dean William D. Funkhouser, University of Kentucky, Lexington, as follows:

> I am certainly happy to be able to get in touch with you again after the Japanese had isolated us for three years from the rest of the world. The campus of my college is very different now from what it was when you and the late Richard C. McGregor paid me a visit several years ago. The retreating Japanese systematically set fire to most of the buildings. At present, we are almost starting again from the very beginning, with all of our collections, library, laboratory equipment, and records destroyed. Even our pedigreed farm animals and selected seeds are gone. I myself was under sentence of death in 1943, but I fortunately escaped with a dislocated left arm resulting from a severe and prolonged torture by the Japanese, and I cheated death for the second time last February when the Japanese massacred the Filipinos wholesale. I have recovered completely, however, and I am again at work with my colleagues on the faculty who nearly all fortunately escaped being murdered.

Recent Deaths

Dr. Waller Smith Leathers, 71, emeritus dean of Vanderbilt University's School of Medicine died at Nashville on 26 January.

Dr. Adriaan Van Maanen, 61, Mount Wilson Observatory astronomer, died on 26 January in Pasadena.

Prof. Leon Marchlewski, 80, Polish chemist and former rector of Jagellonian University, Cracow, has died in Cracow according to the Polish Press Agency.

Dr. Masyck Porcher Ravenel, 84, first bacteriologist of the Pennsylvania State Livestock Sanitary Board, died of pneumonia on 14 January at Columbia, Missouri.

Dr. Ernest Noble Pattee, 81, founder and until his retirement head of the Syracuse University Chemistry Department for 51 years, died on 17 January.

Dr. George D. McLaughlin, 58, Director of B. D. Eisendrath Memorial Laboratory, Racine, Wisconsin, former professor of leather research and director of Tanners' Council Laboratory, University of Cincinnati, Ohio, died 15 October 1945.

Dr. T. A. Tengwall, Swedish botanist and agronomist, formerly vice-director of the Experiment Station, West Java, Buitenzorg; sometime director of the Institute for Tropical Agriculture, Antalya, Turkey, and director of the Research Department, Firestone Plantation Company, Liberia; and lately, rubber adviser to the Board for the Netherlands Indies, Surinam and Curaçao, New York City, died suddenly in New York City on 19 January.

Prof. Harry Bateman, 63, of the California Institute of Technology, died in Utah on 21 January while on his way to New York.

Dr. E. B. Holt, 72, an early behaviorist, died on 25 January in Rockland, Maine. He was a visiting professor of psychology at Princeton University from 1926 to 1936.

Letters to the Editor

CO_2 Baths

R. R. McGregor (*Science*, 1945, 102, 648) spoke of the use of silicone stopcock grease as a means of preventing the foaming in acetone-carbon dioxide "Dry Ice" baths.

His article brought up several points of interest to me, and possibly to other readers. He says that, because of the tendency to foam, "open flames in the vicinity may cause bad fires." The obvious answer to this is to use, as this laboratory does, other noninflammable liquids. We use a commercial brand of trichloroethylene, called "Triad" (DuPont Co.), as degreaser solvent. This solvent will not support combustion, gives all the effects that acetone does with "Dry Ice," and therefore has none of the fire hazards of acetone.

In several simple experiments after reading Mr. McGregor's article, it was found out that if the acetone is reasonably clean it will not foam anyway. In another experiment, the effect of silicone grease on trichloroethylene was determined. In this solvent, instead of cutting down the foaming—trichloroethylene will foam badly, too, at first, if it has been used repeatedly—the silicone increased it manyfold.

Croom Beatty, III, *Director*
Organic Research Laboratory

Sprague Electric Company
North Adams, Massachusetts

The Age of Lake Cahuilla

Lake Cahuilla is the name given by W. P. Blake to a very large shallow lake, covering an area of about 2,200 square miles, which formerly existed in the region of the present Colorado Desert. Long ago it dried up, leaving on the surface of the soil millions of fresh-water shells, both univalves and clams, of several different species. These species are living today, in much smaller numbers, in various parts of the west.

Much discussion has recently arisen concerning the age of this lake, some geologists thinking it might have existed as recently as 500 to 1,000 years ago. The end of the Pliocene period in California is not strongly marked in the marine formations, but on land or in the fresh waters it is abrupt, suggesting a considerable time interval. All the Pliocene birds are extinct; the Pliocene fresh-water shells described by Pilsbry are nearly all extinct, the exceptions being a few uncharacteristic forms; the Pliocene plants are regarded as extinct, though to some extent this is a matter of convention, the scanty remains showing no appreciable difference in several cases from living species. When we come to compare the next period, the Pleistocene, with the Recent, there is no such break. It is not unreasonable to say that we are still living in the Pleistocene. Hence, when we dispute whether Lake Cahuilla is Pleistocene or Recent (Holocene), the decision may not be evident. But during the Pleistocene, as is now well known, there were wet (pluvial) periods, alternating with relatively dry ones, and no doubt these vicissitudes had much to do with the extinction of various elements of the fauna and flora. The last of these pluvial periods, near the end of the Pleistocene, seems to be the period of Lake Cahuilla.

We seem to have various evidences of this pluvial period in southern California. The fauna of the tar pits at Los Angeles, including large herbivorous animals, such as elephants and mastodons, could hardly have been supported by such vegetation as now exists in the region. The subfossil land snails on the islands off the coast, especially San Nicolas Island, are so abundant as to suggest abundant vegetation, though it is true that the present denuded condition of the islands is largely due to the grazing of sheep. But Lake Cahuilla itself seems to furnish evidence of a pluvial period of long duration. Such a large shallow lake, supporting an enormous population of mollusks, must have existed for a long period, but it remained strictly fresh water until near the end of its existence, when the marine genus *Acteocina* appeared. This genus is represented, sparingly, by a minute species, which Willett described as new. Now the Salton Sea was formed as recently as 1905, when the Colorado River flooded the Salton Sink, an area below sea level. It is the fresh water which makes the sea salt, as the result of evaporation, and under present climatic conditions the Salton Sea has now become as salt as the ocean. It does not seem possible that Lake Cahuilla could have remained fresh under climatic conditions such as exist today.

More study of Lake Cahuilla is needed, and interesting discoveries may be made. Dr. W. O. Gregg writes that he has found an additional mollusk in the deposit, *Pyrgulopsis nevadensis* (Stearns), and suggests that still others may be found.

T. D. A. Cockerell

Box 411, Palm Springs, California

A Critique of the "Exact" Natural Sciences

The current widespread discussions on the subject of the proposed science legislation have brought forth again the old problem of the "exact" natural sciences and the "inexact" social studies. At the risk of incurring wrath from both sides, I should like to state a view which, unfortunately, has not been generally considered.

The apparent basis for the argument is that the "exact" sciences deal with subjects and materials which are under rigorous experimental control of the investigator, while the "inexact" sciences are mainly concerned with the irrational and, at times, irresponsible activity of a mass of individuals amenable only to a statistical treatment. The apparently rather general acceptance of this state of affairs leads one to consider the actual merits of such a differentiation; such consideration, it is sad to say, does not lend too much weight to the claims of the former group. At this point, the writer wishes to mention that in all such discussion his arguments have been with the "exact scientists" in a general sort of way and that the following line of argument is based on a long period of work in the "exact" sciences (specifically, organic chemistry). The general examples to be cited are based on general practice in organic chemistry, which is, after all, a fairly representative branch of the natural sciences.

The science of organic chemistry is based essentially on a collection of observations which were made on the behavior of physical entities and agglomerations of these. The materials under observation must be regarded as statistical aggregates of a large number of molecules possessing a variable degree of identity, which is controllable to a certain degree by the manipulations entailed in the preparation of such aggregates. It must be conceded that any of the commonly used methods of purification and separation are essentially statistical methods, which cannot lead to the degree of isolation which can be used to justify the commonly-met statement: "pure compounds." Speaking in the sense of absolute logic I do not believe that anyone is justified in saying that this heap of crystals or that vial of liquid is a collection of identical molecules. There is no fractionating column in existence nor a crystallization technique nor any other physical or chemical method capable of absolute separation of materials in the course of an investigation. Whether one starts with the fundamental natural sources or buys the starting material as a "pure starting material" from a scientific supply house, the problem of separation is ever present. Now, the great bulk of work in the field is done with materials which are purified to the practicable extent and represent aggregates which show the gross variations of one unit or somewhat less in their most commonly used indices of purity: the melting point and the boiling point. Much of the technical work is done on materials with considerable extension of this range. Some work, essentially on standards, has been more exacting, but even here the justification for absolute identity of the aggregate is a matter of concern. Let us say, then, that the bulk of the organic chemistry is based on observations of compounds which are 99–99.8 per cent pure, with the emphasis being perhaps on the first figure. Even in the latter case a mole of such a compound will contain 1.2×10^{21} molecules of other substances which were either picked up en route during the manipulations or remaining from the initial starting material. Now, relatively speaking, this number is small; in the absolute sense it is a very large one. It must be conceded that the work in the field of catalysis shows at times spectacular effects produced by materials which are present in fractional per cent amounts in a given mixture; the effects of biological catalysts are at times even more pronounced. Therefore, is there a justification for the neglect of the presence of such large numbers of molecules as cited above in materials under study in so far as the chemical behavior is concerned? Of course, there is the practical justification which can be carried to the logical conclusion, which is that there is no physical apparatus possible (at least in our present state of knowledge) capable of absolute resolution of molecular aggregations. But this is just another way of saying that our "exact" science is not exact; that we do not really *know* that many reactions are or are not initiated by at least some of those miscellaneous molecules which are swarming in our "pure" compounds. These reactions need not be the spectacular ones induced by the well-known catalytic agencies, but merely the "everyday" classical reactions. We see the gross statistical effects only and have little or no true representation of the actual events.

Does not this seem to be similar to the criticisms leveled at the "social" scientists? Certainly, there is a striking parallel between the "materials" under study. As a matter of fact, the social sciences, especially in recent years, have devoted much time and effort in dealing with problems induced by relatively small fractions of national population. As an example, a well-known radical party which numbers some 50,000 members, *i.e.* some 0.03 per cent of our population, has had more words written about it by the "inexact" scientists than have been written by the "exact" organic chemists on the "missing" 1 per cent (or somewhat less) of their materials. On this basis, how much logical separation can we make between the two fields of work?

G. M. Kosolapoff

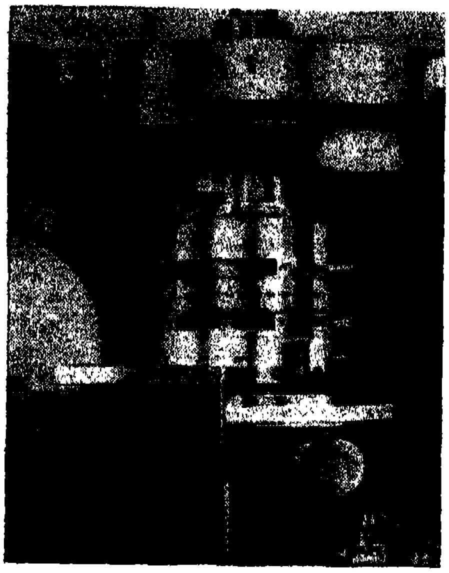
Monsanto Chemical Company, Dayton

Pandora's Box

The Army and the Navy appear to be determined to go ahead with experimental atomic bombing of naval vessels, despite the grave warnings by some physicists that any uncontrolled release of atomic energy might set off a chain reaction which would detonate the entire earth, and despite the fears of biologists concerning the possible effects of a subsurface explosion of an atomic bomb on marine life. The announced plans to carry out this experiment in the face of these warnings betrays a profound lack of understanding of the force which scientists have placed at the disposal of military men, and a regrettable paucity of imagination and lack of concern for other life on this planet. The chief concern of mankind should be the prevention of any further release of the atomic bomb: Hiroshima and Nagasaki are examples enough of its power, and adequate warning of the shape of things to come, and this unnecessary and dangerous experimental bombing should be abandoned before it is carried any further. Certainly its possible effects, in the light of our present inadequate knowledge, should be called to the attention of every one concerned in this scheme. War is out of date, and even admission of the possibility of future wars is welcoming the premature extinction of mankind. It is already far later than our military minds think it is.

Joel W. Hedgpeth

Texas Game, Fish and Oyster Commission, Rockport



BAUSCH & LOMB ELLIPTICAL VIBRATION COMPENSATOR

THE Elliptical Vibration Compensator, used with the Bausch & Lomb Research Metallographic Equipment, provides the mineralogist with an important research and analytical tool. Through its use, reproducible quantitative measurements in polarized light reflected from opaque minerals can easily be made. Doubly refracting metals and opaque minerals can be classified. Small amounts of double refraction of mineral components in opaque structures can be detected.

The Elliptical Vibration Compensator, placed directly above the Foster vertical illuminator prism, permits determination of the amount of rotation of the plane of polarization as well as resultant phase shift which is characteristic of the specimen. The two factors are read directly on two separately rotatable elements consisting of a quarter-wave film between glass prisms and a thin mica plate. For complete information, write Bausch & Lomb Optical Co., 642 St. Paul Street, Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

Book Reviews

The falling sickness: a history of epilepsy from the Greeks to the beginnings of modern neurology. Owsei Temkin. Baltimore: Johns Hopkins Press, 1945. Pp. xv + 380. (Illustrated.) $4.00.

This monograph, which is Number IV in the publications of the Institute of the History of Medicine, Johns Hopkins University, traces the history of epilepsy, or the falling sickness, from the ancient Greeks to the point where historical perspective ends and the present debate begins. This latter point is considered to be about 1880, when the impact of Charcot's and Hughlings Jackson's work made itself felt. The author felt that, since he was not a neurologist, he was not qualified to pass judgment on the works of recent decades. His aim is to present the past with a view of helping the reader to understand the setting of the present problem. The evolution of the various ideas concerning epilepsy is traced from the sacred disease in antiquity, the falling sickness in the Middle Ages, to that of more recent times when psychological concepts were discarded and the epileptic phenomena were explained on basis of physiological disturbances in the brain.

Treatment of the disease at the various stages in the evolution of the concepts regarding it is discussed fully from the magic of ancient times to the introduction of the use of bromides by Locock and Wilks in the latter half of the Nineteenth Century.

The book is well documented by over 700 references and there is a good index. Students of the history of medicine and physicians who are interested in the treatment of this important disease, which afflicts nearly one million people in this country, are greatly indebted to Dr. Temkin for his excellent presentation of its background.

H. Houston Merritt

Montefiore Hospital, New York City

Engineering preview: an introduction to engineering including the necessary review of science and mathematics. L. E. Grinter, Harry N. Holmes, H. C. Spencer, Rufus Oldenburger, Charles Harris, R. G. Kloeffler, and V. M. Faires. New York: Macmillan, 1945. Pp. x + 581. $4.50. Home Study Edition: Pp. x + 619. $6.00.

Intended for junior or senior high school students or college freshmen, this well-written and well-printed work aims to give the reader an insight into engineering, primarily for the purpose of enabling him to decide whether or not to take up engineering as a life work.

Although one may differ with the authors on details of engineering evolution, the first chapter gives the reader a perspective that should be very helpful and is too often lacking. The chapter includes a "parlor test" to determine engineering aptitudes. The logic of including this material in the book rather than in a separate pamphlet may be questioned. If the "home study" reader "flunks" this test and takes the result seriously, he would have no need for the remainder of the book. Likewise, for classroom work, it would seem more logical to take this test before enrolling in the course instead of as a part of it. The reader who passes the test will find much of value in the remainder of the book, including a good refresher course in essential mathematics.

Chemistry is treated in the second chapter of about one hundred pages, and the treatment appears excellent for its intended purpose. After dealing with the nature and importance of chemistry, the chapter deals in a limited way with many phases of its various branches and includes some material that usually is considered as atomic physics.

Although physics is emphasized in the introductory chapter, the work does not include a chapter on that subject. The sixth, seventh, and eighth chapters, however, deal with four of the subdivisions of physics, viz., Light, Electricity, Mechanics, and Thermodynamics, and with the engineering applications of these sciences. Missing are treatments of the nature of light and of sound and hydraulics.

Following the chapter on Chemistry, there is a well-illustrated, hundred-page chapter on Technical Drawing which should be a valuable part of a book which is to serve the intended purpose.

An extensive chapter on Mathematics provides a good introductory course up to, but not including, the calculus. The chapter concludes with work on curve fitting, and nomographs. Over fifty pages of good mathematical tables are placed at the end of the "classroom" edition, but ahead of the two extra chapters in the "home study" edition.

A thorough treatment of the slide rules commonly used by engineers is given in a chapter which follows the one on Mathematics.

The only difference between the "home study" edition and the "classroom" edition of this book is that the former includes, at the end, a chapter on Writing a Technical Report, and one comprising a Comprehensive Examination. This includes a key so that the reader may grade his own accomplishment. The material on technical report writing is very well done and should prove very valuable to the "home study" student.

The reader may be somewhat confused by a statement in the first paragraph of the chapter on Mathematics, which seems to conflict with some carefully drawn distinctions between an engineer and a scientist, given in the early pages of the first chapter. The former statement indicates that a scientist is an engineer who uses mathematics. The distinction drawn in the first paragraph is much better. Also confusing is a statement in the chapter on Technical Drawing which implies that the usual, black-lead drawing pencils produce *colored* lines.

The chapter on Mathematics includes an explanation of the process of finding the lowest common denominator which does not explain. Also, the discussion of "per cent'' includes the confusing statement: ''The number 1 is 100%.'' As used, this statement is correct *before* the decimal point is shifted, but not *afterward*.

The discussion of slide-rule errors in the chapter on that subject could be improved to bring out more fully the limitations of the commonly used slide rule. The statement that ''slide-rule answers are accurate but not exact'' is hardly sufficient. In fact, the authors would have done well if they had included a brief chapter, written in their interesting style, on the usually dry subject of measurement, tolerances, precision, accuracy, and limits-of-error. Such terms as ''exact'' and ''accurate'' mean little in engineering unless carefully defined. No mention is made of calculating machines as used for mathematical work in which slide-rule errors would be too large to tolerate.

The abbreviations of terms do not in some cases follow the recommended practice of the American Institute of Electrical Engineers—for example, a-c should be used instead of a.c.

The errors and inconsistencies appear to be few indeed for a first edition, and both books are likely to be popular with many eager students.

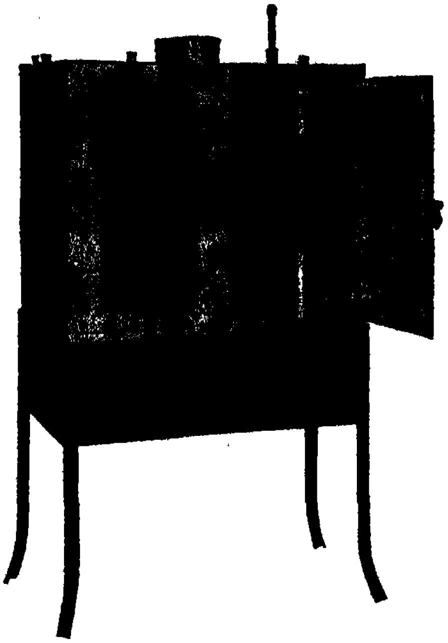
I. Melville Stein

Leeds & Northrup Company, Philadelphia

Infrared and Raman spectra of polyatomic molecules. Gerhard Herzberg. New York: D. Van Nostrand, 1945. Pp. xiii + 632. (Illustrated.) $9.50.

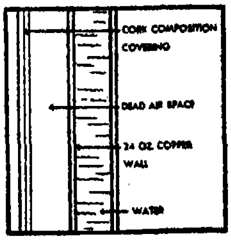
This comprehensive treatise constitutes the second of a series on molecular spectra by a competent writer and will be cordially welcomed by all who have a serious interest in this field. It is, however, primarily a book for the specialist, and for its enjoyment a reasonable previous knowledge of the subject is a prerequisite. The extent of the material covered and the adequacy with which it has been treated may be judged by the 978 literature references and the complete subject index of 65 pages, which greatly enhance the value of the book as a reference.

The organization of the book is very logical, though possibly at the expense of introducing certain pedagogical difficulties, since the phenomena to be explained and their interest and relation to other knowledge do not become fully evident until the later chapters. In the Introduction a discussion of the symmetry properties of molecules is immediately presented, greatly facilitating the later discussion. Chapters I and II, which deal with Rotation and Rotation Spectra, and Vibrations and Vibrational Energy Levels, respectively, are primarily a theoretical discussion of the arrangement of the energy levels of molecules, of their degeneracy, and of their symmetry properties. The treatment is very complete, and, as in other sections of the book, alternative approaches to a given subject are often presented. In many cases proofs are not given, which occasionally seems unfortunate. For the reader who is not interested in theory for its own sake it may appear that undue



HERE'S WHY *Castle* PRECISION INCUBATORS Give rigid temperature control

It is the Triple Wall of the Castle Precision Incubator that guarantees exactness in incubation. A water jacket enclosed by dead air space surrounds the chamber on all sides. Carefully regulated heat applied to the water in the jacket heats the chamber by radiation, which means uniform penetration throughout.



These triple-wall, water-jacketed incubators are preferred for these features:

⅞° C. Uniformity: Never as much as a degree variation between top and bottom of chamber when loaded.

½ to ¼° C. Constancy: Never more than a fraction of a degree variation at the thermometer—even though room temperature may fluctuate between 10 and 35° C.

Humidity: Fresh air circulates through chamber constantly. This air is preheated in tubes passing through water jacket.

98% Usable Capacity: Practically no space is wasted by heaters or controls, or by ''hot and cold spots.''

For further information on these Castle Precision Incubators, write: Wilmot Castle Co., 1212 University Ave., Rochester 7, N. Y.

Castle BACTERIOLOGICAL APPARATUS

space is devoted to some particulars which will seldom, if ever, be observable by experiment.

It is not until Chapters III and IV that the significance of much of the preceding discussion will become evident to the reader who is not fully conversant with the subject. For many readers the main value of the book will lie in these chapters. In Chapter III, after an introduction to Vibrational Infrared and Raman Spectra, an exhaustive and critical review is given of existing data on all molecules up to the twelve-atomic. The unsatisfactory condition of certain analyses is pointed out, and this section should prove stimulating in its suggestions for future work. Chapter IV deals with the Interaction of Rotation and Vibration and is adequately illustrated by representative examples of vibration-rotation spectra. The collections of molecular constants obtained from rotational analyses will be useful for reference. Chapter V, which concludes the book, deals with the applications of molecular spectroscopy and is comparatively brief. It may prove somewhat disappointing to certain readers. Had it been more comprehensive, the need for the book itself would have been more evident.

The scope of the book and its possible relation to future applications of spectroscopy is naturally restricted by the fact that it deals with molecules of a limited size, for which a more or less complete analysis of the spectrum can be anticipated. This is illustrated by the fact that the most significant spectroscopic investigations on intramolecular hydrogen bonding have not been mentioned, and that other qualitative, though important, applications of spectroscopy have not been covered.

It is unfortunate that it was necessary to print this book in a type which is at best too small and, in very considerable sections, so small as to be a very severe strain on the eyes.

RICHARD M. BADGER

Gates and Crellin Laboratories of Chemistry
California Institute of Technology, Pasadena

Uranium and atomic power. Jack De Ment and H. C. Dake. Brooklyn: Chemical Publishing Co., 1945. Pp. x + 343. $4.00.

The uranium atom, possessing as it does extraordinary chemical as well as nuclear properties, is a difficult subject for a book. The usual procedure is to stress either the ordinary chemical properties of such an element or its nuclear or radioactive properties, but not both. The present volume does not deviate in this regard. It is far more concerned with the chemical properties of the element than with the properties of its nuclei, though it pays extended attention to some of the more recent and spectacular results. One finds a considerable increase in emphasis on the atomic energy in contrasting this second edition with the first edition, which is understandable.

As a chemical treatise, this volume is extraordinary. It reports in some detail a considerable number of facts about uranium and uranium ores which are normally omitted in standard reference volumes. For this reason, it has some real interest. On the other hand, the chemistry is rather incomplete and unsystematic. No serious attempt is made to correlate the properties of uranium with the neighboring elements of the periodic table, and great stress is laid on certain less fundamental properties, such as the fluorescence of uranium salts.

On the whole, this volume is a sort of collection of bits of information about the ordinary chemical and mineralogical properties of uranium compounds, with a considerable amount of rather heterogeneous writing about the more spectacular nuclear properties of the element. The title of the volume is misleading, because little of an authoritative nature is said about atomic power.

W. F. LIBBY

Institute for Nuclear Studies, University of Chicago

Kilgore-Magnuson Bill

(Continued from p. 230)

DEFINITIONS

SEC. 12. As used in this Act—

(a) "Research and development" means theoretical analysis, exploration, and experimentation in any field of science (including but not limited to the mathematical, physical, biological, medical, engineering, and social sciences), and the extension of investigative findings and theories of a scientific or technical nature into practical application, including the experimental production and testing of models and processes.

(b) "Federally financed research and development" means research and development conducted directly by the Federal Government and all other research and development financed in whole or in part directly by the Federal Government from funds designated for research and development, under a contract, grant, or other direct form of financial assistance for research and development.

(c) "Government agency" includes departments, independent agencies and commissions, corporations, and other instrumentalities of the Federal Government.

(d' "Organizations includes State and Local government agencies, corporations, partnerships, nonprofit institutions, and individuals.

(e) "Scholarships and fellowships" means stipends covering tuition and other fees, and such living, travel, and other expenses as the Administrator may determine.

Scanning Science—

At a meeting of the New York Section of the American Chemical Society it was announced that several steel and iron companies in this country have already established very complete micrographic laboratories, where in three hours an accurate determination of the condition of any specimen of the daily output may be secured.

—7 February 1896

SCIENCE

Vol. 103, No. 2670 Friday, March 1, 1946

Science and Man's Dilemma

Bruce L. Melvin

Secretary, Section K, AAAS

THE PHYSICAL LAWS used in the production of the atomic bomb were not new to the physicists; but it took the destruction of two Japanese cities to reveal to the mass of humanity the fact that man today, as never before, has the power to destroy himself completely. Humanity is now haunted by an uneasy fear that an unconquerable monster has been released. But uneasiness and alarm possessed the student of human welfare before Hiroshima was destroyed. Lewis Mumford, months prior to that date wrote:

> Modern man is the victim of the very instruments he values most. Every gain in power, every mastery of the natural forces, every scientific addition to knowledge, has proved potentially dangerous because it has not been accompanied by equal gains in self-understanding and self-discipline. We have sought to attain perfection by eliminating this human element. The disproportionate development of the sciences themselves only hasten the benign end (*The condition of man*, p. 393).

This quotation crystallizes two most disturbing questions: Does humanity know how to live with the physical power it possesses? Can science, or can man by using scientific methods, control his own destiny?

Preponderating evidence forces negative answers to both these questions. World War II, with its wholesale destruction, is followed by starvation, cold, and disease. The United States failed to solve its human problems of poverty and unemployment that broke the spirit and injured the health of millions during the 1930's. It took the global cataclysm to provide jobs for the mass of our working population: unemployment was conquered by forces of destruction rather than by constructive effort.

America and American scientists now hold a unique position of power on the one hand and a national and a global responsibility on the other. Spengler observed prevalent characteristics of the German society, and upon his observations forecast the doom of the West. Concentration camps and scientifically designed murders attest the ability he possessed to perceive trends. A dominant fear on the part of the student of cultures now is that German depravity was only a forerunner of a general depravity towards which all Western civilization is descending. To examine this possibility and to help define more succinctly the dilemma facing science a few facts respecting trends in pre-Hitler Germany and present-day America are first given, followed by a few suggestions as to what scientists may do.

PRE-HITLER GERMANY

The pertinent fact about Germany, for the scientist, is that Germany was a world leader in science before World War I and between the two wars. Unhappily, the years between 1933 and 1939 saw the scientists of that country make a retreat from the free spirit of scientific discovery and become not free men but Nazi tools. Some of the great scientists fled, but the majority—as did the German Universities—became only putty in the hands of a state morality that used scientific methods to perpetrate legalized crimes and inflate the egos of the perpetrators. The philosopher of degradation, Spengler, some years before Hitler, did not see science as a tool in the service of man, but saw in it an instrument for the attainment of the supremacy of a few over many, as the rule of the technics, and as a means of routinizing and devaluating the individual. Though he marshaled his facts from the entire panorama of history, he could not have ventured on such a thesis had he not felt the chilly winds of Germany's mechanized objective life on the one hand and her subjective fear, frustration, and insecurity on the other. It was from a people, part of whom were highly trained in scientific methods but who had lost hope of securing jobs or making their adjustment into society, that Hitler built his regimented machine. The Germans, trained and untrained, who had suffered from insecurity and frustration were willing to fall into the goose step when ordered, to accept supinely a suggestion to persecute the Jews, or to desist from any act, regardless of how strongly it might be morally impelled, if it was "verboten."

Out of race prejudice Hitler erected race hatred and race slaughter; from personal despair, frustration, and social disorganization he built individual pride and his "new" social order. By accusations, persecutions, haranguings, marching, singing, Hitler brought unity out of disunity, fanaticism out of despair, transferred feeling of guilt and failure from the Germans to others, and set his nation on the high road of its own destruction. All this after a distinguished record of accomplishments in science! Pertinent to this fact Lewis Mumford asks:

> Had not Germany long led the world in philosophy, in music, in scholarship, in the sciences? So convinced, indeed, was a large part of mankind of the soundness of this civilization that it refused to heed the malignity of the Fascists' inventions or the hideous results that flowed from them (*The condition of man*, p. 369).

Then there was the wild inflation and the economic depression in which security was taken from millions overnight. Germany could not withstand the impact of poverty and widespread unemployment. Hitler gave work. Indeed, it may be observed that a spearhead—if not *the* spearhead of the early Nazi movement—were some 50,000 technically trained college men who could not find a niche in Germany's economic organization.

SYMPTOMS IN AMERICAN LIFE

It would be foolhardy to assert that America will immediately go the way of Germany, but some of the same symptomatic trends of destruction once prevalent in Germany may be observed in America. An eminent economist, some three years ago when under fire by a Congressional Committee for what the Congressmen thought he believed, said to the author: "In 1933 I told my German friends in Berlin what was coming. They would not believe me. Now I fear for the United States." A second widely known American scholar, who lived for three years with a Nazi husband in Germany during Hitler's ascendency, recently remarked: "I see so many signs in America, like those so prevalent during those years, that I shudder for the future." Neither of these is an alarmist; both are highly trained social scientists.

One of the most vicious of these signs is race prejudice, which has raised its ugly head out of many psychoeconomic quagmires since Pearl Harbor to strike violently against the American-born Japanese, the Negroes, and the Jews. This green-headed hatred, if limited evidence can be trusted, appeared more and more frequently and in widely scattered places as America approached victory. Within a few months preceding VE-Day there were 16 shooting incidents in California directed at the Japanese-Americans. Mrs. Agnes Meyer, in the *Washington Post*, 4 May 1945, wrote: "In California Americans of Japanese extraction are being terrorized with shootings and dynamite bombs, yet the terrorists are exonerated by juries on the statement of their council, 'This is a white man's country.' Prejudice, fear and greed prevent the local authorities from protecting the homes of our fighting men whose parents were Japanese." Moreover, the Supreme Court approved "our worst war-time mistakes," the removal of the Japanese from the West Coast, which, according to Eugene V. Rostow (*Harper's Magazine*, September 1945), "was an injustice in no way required or justified by the war."

Other types of race hatred have sprung up like weeds in a fertile field. Anti-Jewish antagonism appears to have been systematically organized in New England. In some cities hatred has been intensified against the Jews and, in other places, against the Catholics. Not all who know the situation are opposed to it. Racial hatreds and accompanying violence stem from definite psychological characteristics of individuals and economic and sociological traits of the society. Hatreds accompanied by jealousy, a feeling of insecurity, frustration, disappointment with life goals, the desire for dominance, and a paucity of individual and social guidance of ideals are among the maladies of man's spirit. These are the subjective traits of the inner man that parallel social disorganization. America was badly disorganized during the 1930's but did not know it. The failure then to meet the human problems of inadequate food and protection of health was a national scandal later revealed by the Selective Service examinations. Of 10,000,000 men examined by local draft boards between 7 December 1941 and 31 December 1943, 3,600,000, or over one-third, were physically unfit. Before Pearl Harbor, when the physical standards were at their highest level, 52.6 per cent of all men examined were rejected. Those who studied the problems of the growing numbers of unemployed and maladjusted youth during the 1930's were in no way surprised that the report on the "Physical examinations of Selective Service registrants during the war-time" read: ". . . while the standards maintained by the military forces have been admittedly high, the prevalence of disqualifying defects has become a matter of national concern, not only from the viewpoint of the armed forces, but from the standpoint of national health as well."

Other prewar characteristics reveal the amnesia in our social body. The marked phenomena of the 1920's were the dominance of gangsterism, lawlessness and a mad race for gain by chance and speculation, and the heavy migration from country to city. When the United States floundered in the whirlpool of depression, all ameliorative measures were constantly machine-gunned by intrenched interests and well-intentioned guardians of the status quo. Our real moral flabbiness was most blatantly revealed in our refusal to raise a finger against international aggression, first in Asia and then in Europe. We turned against the gangsters when their depredations became so widespread that no citizen was safe; we arose against the international gangsters after we were attacked.

Then there is another possibility: the United States may follow a course of inflation and complete disorganization. If the United States again goes on a wild spree of buying, selling, and speculation, it is to be expected that we shall plunge into another depression in which all the above-mentioned trends which lead to an authoritarian society will rush forth like a desert brook—having only trickles in the dry season but a dangerous, devastating flood when the rain comes. The symptoms of complete social and economic disorganization are with us. Strikes, picket lines, tear gas, refusal to compromise—all are marks of growing factionalism, distrust, fear. These maladies cannot be put down by the physical inventions, but they may be cured by the scientific method.

SCIENCE AND THE FUTURE

What happens in America will go far in determining the destiny of the world. Moreover, if we cannot solve our own problems, how can we give adequate aid to those baffling situations that belong to world affairs? There are two courses to follow: to accept the destruction of man as inevitable, or to take hold of national and world problems involving the biological and psychological man, and economic, political, and social relations in both national and international realms.

The implications of the foregoing discussion, when coupled with man's new-found atomic power, are ominous; they forecast the inevitable rapid destruction of man, the first of these alternatives. This is in accordance with conclusions held by some scientists. For example, Dr. Gerrit S. Miller, Jr., writing in *Science,* when the man on the street had not dreamed of the atomic bomb (*Science,* 1941, **94**, 163–164), said:

> . . . in his mental constitution man unites the dominating type of social behavior that is common to most anthropoid primates . . . with such a unique genius for "implementing" it as to make a totally new phenomenon in animal evolution. This combination may well prove to be, in the end, as racially lethal as the huge size and great bodily specialization of titanotheres, proboscidians and dinosaurs appear to have been in the past.

That type of social behavior is *domination* or, as the psychologists may call it, the desire to dominate. War, the desire for huge fortunes, the urge to surpass others (all basic in our economic, political, and social systems) are expressions of this primate characteristic, if the present writer understands the quotation correctly. Science has now put into the hands of the highest form of primate the power of his own destruction.

But what has science to offer man by which he can save himself? What can science offer the American politician as well as the American citizen that it did not give to the Germans? The first contribution it can make is the basic philosophy that has made science possible, namely, the openminded search for truth. Respecting racial hatreds, the anthropologists have amply shown that there are no basic differences among races. Therefore, scientists of all types have the responsibility of helping to put that fact into practice in our society.

If this is to be done, it requires man, the primate, to conquer his own innate characteristic, which is the urge for domination. It is in this respect that "modern man is obsolete, a self-made anachronism becoming more incongruous by the minute. He has exalted change in everything but himself. He has leaped centuries ahead in inventing a new world to live in but he knows little or nothing about his own part in that world" (Norman Cousins. *Modern man is obsolete.* New York: Viking Press, 1945).

As human beings we do not like to accept destruction as inevitable or to feel that the biological and psychological man is obsolete, but to solve the socioeconomic and sociopsychological problems or to control the trends in these fields, science must push back many frontiers and at the same time apply the scientific method to the results of its own discoveries. The physical, biological, and social sciences have made greater advancement in the past 50 years than during the preceding 50 centuries. The fact that the advance of science may be paralleled by public and personal moral decay is enough to challenge the most critical, especially if he has any interest in human society beyond his own laboratory or personal advancement.

Pure scientists must become human beings and not claim for themselves the right to be independent of all values. No one can question this as a requisite for advancement in science, but the maintenance of pure science does not excuse the scientist from applying his methods to the problems of human society. It is the belief of the present writer that the scientific method can be used in planning for the coming atomic age. The coal age, the petroleum age, the electric age were ushered in with no foresight. Hogben, in his *Retreat from reason,* has this to say: "We blundered into the age of coal and steel with no provision. We are now blundering on the threshold of an era of technical changes which may have more drastic consequences" (p. 63). Scientific method has shown the way to extrapolate in dealing with physical and biological facts. This same method can be used in the social sciences to project an economic, social, and political organization that will meet man's external needs, especially in relation to the human values, health, love, emotional adjustment, and security.

Physical, biological, and social scientists can no longer remain compartmentalized. This applies to all types of problems whether they be those of housing and slum clearance, developments of more nutritious soya beans, or the cure and prevention of the development of millions of physical, mental, and emotional defectives such as were found by the draft. The defects of those from the Appalachian Highlands rejected by the draft should be studied by the economists, sociologists, psychologists, nutritionists, soil chemists, as well as specialists in public health.

The English scientists appear to be pointing the way along these lines; at least they are very much alive to the situation. Their general position, given in *Advance of science,* August 1943 and September 1944, two publications of the British Association for the Advancement of Science, are here presented.

Science, which is the search for truth, devotes itself to the study of the universe in which we live, "especially to the study of the natural processes by observation and experiment." But the truths that have been discovered through science have been directed away from the humanities. In fact, the natural sciences lost their place among the humanities "when the technological demands of modern institutionalism claimed for themselves a status apart from and alternative to the 'more humane' studies as it became the fashion to call them, in the hope of producing experts and specialists in some one line of lucrative research at the age of twenty-two or twenty-three" (Prof. Sir John L. Meyers, F.B.A.). Perhaps by reason of high specialization during the war years science, necessarily and with success, was turned to the augmentation of destruction. This had to be. Moreover, future historians will tell us how close Germany, through her technical power, came to destroying England and holding the European Continent.

From mature thinking, the British scientists have concluded that the function of science is to serve society in ways other than by providing machines and gadgets for commercial channels. They see a sphere of activity and service far beyond these limits. They hold that "there is no department of human activity that cannot be approached in the scientific spirit" (F. R. G. Duckworth). Recognizing the power of science, another wrote: "But now that science is on its way to a place in the sun, is there no risk of our failing . . . to turn out balanced citizens? It seems to me that the risk is great—and all the greater because in these war years our energies have been rightly concentrated on practical ends—unless we are prepared to face the question squarely, what is the cultural value of science?"

Further conclusions provide a base for the scientist who is interested in the ills of humanity. "European civilization has not yet decided the exact form of the more social view of man to which it seems to be returning." In contrast to the authoritarian approach such as that pursued by the Nazi, "we should like to see clearly the development of an outlook which would continue to affirm the value of the individual while at the same time seeing him as a being formed by and forming the society of which he is a member . . . the sciences that treat man as a complete organism have been very little developed" (Dr. C. H. Waddington).

"The pivotal question of the postwar reconstruction is the ordinary living of the ordinary man. This is where the citizen meets science and has to meet problems of applied science most frequently and most urgently. But the central scientific subject . . . is most often overlooked and is the most important of all. I refer to the human. . . . According to the psychologists, no man is complete and healthy unless he has moral or ethical standards which he feels he can trust" (Mr. N. F. Sheppard).

The responsibilities of the scientists were recognized. "The time has now come when every scientist must realize how his work is related to social and economic conditions. It is clear, that as much as any class of workers, it will be even more evident that reconstruction, if it is to be successful and permanent, must be built within such a social framework that it is able to give to the community the full benefits which accrue from the work of the scientists. . . . We must make our work in the field of the social relations of science a living force of immediate effectiveness and value."

ACCEPTANCE OF RESPONSIBILITY

Many scientists of America are awake; they see the ills of human relations (intra- and international) and the dangers of aggravating those ills. Lawrence K. Frank pointed out (*Science,* 1945, **101**, 433–434) that the major threat of our age is the discrepancy between advancing technology and our established practices and organizations. Dr. Harlow Shapley (*Harper's Magazine,* October 1945), aptly states that in Russia the conception of science is much broader than among us. There the social and historical sciences are on a par with the physical and biological sciences. Captain John G. Jenkins, USNR, in speaking on the subject, "New opportunities and new responsibilities for the psychologist" (*Science*, 1946, **103**, 33-38), asserts that psychology must of necessity enter "the stage of *social* loyalty and social responsibility."

In the hearings on the establishment of a National Science Foundation, before the Subcommittee on War Mobilization of the Senate Committee on Military Affairs, recognition was given to the necessity for a unified approach to the problems of mankind. Dr. F. R. Moulton, Permanent Secretary of the American Association for the Advancement of Science, an eminent mathematician and astronomer, urged the necessity of including the social sciences in any program involving the research of such a foundation. The testimony given in these hearings largely supported the position that the Government should support research in all fields of fundamental scientific inquiry. Then the President, in his message recommending legislation for scientific research, asked for the inclusion of the social sciences.

These are all straws pointing in the wind, but there are adverse currents. We who believe in the position taken in this discussion can only be satisfied when there are strong signposts telling exactly where we are going.

Association Affairs

Revision of the Association's Constitution

A Statement by the Special Committee on Constitution and Bylaws

Otis W. Caldwell, Burton E. Livingston (*Chairman*), and F. R. Moulton

AT A MEETING HELD 11 NOVEMBER 1945, the Executive Committee directed that the proposed revision of the Association's Constitution be republished in *Science* and that it be presented, as an amendment to the present Constitution, for ratification at a general session of the approaching fourth St. Louis meeting. It is here published for the second time, as it appeared in *Science* for 1 September 1944. The present Constitution was last published in *Science* for 6 June 1941. It is published again here to facilitate comparison.

The original "Objects and Rules of the Association" were amended to become the First Constitution in 1851. A partial revision was made in 1856, and the Second Constitution was ratified in 1874, at which time the Association was incorporated under the laws of the Commonwealth of Massachusetts. Prior to 1887, the Standing Committee of the Association controlled Association affairs, but in that year the Standing Committee became the Association Council. The Council has been the official governing body since that time.

In 1917 a special committee—consisting of J. McKeen Cattell, *chairman*, Herman L. Fairchild, and Daniel T. MacDougal—undertook a thorough revision of the Second Constitution. On recommendation of that Committee, the Third Constitution was ratified at the third St. Louis meeting. With a few minor amendments, it has been in force since 3 January 1920.

On 30 December 1939 the Executive Committee of the Council named a special committee to revise the Constitution still further. That committee consisted of B. E. Livingston, *chairman*, E. R. Long, and F. R. Moulton. On the resignation of Dr. Long in 1942, because of pressing duties connected with national defense and the war, the Executive Committee named Dr. O. W. Caldwell to succeed him. After intensive study of numerous suggestions and proposals, some of which had been brought forward in a prolonged discussion at the Dallas session of the Secretaries' Conference, this special committee presented a proposed new Constitution to the Executive Committee on 6 August 1944, recommending that this document be submitted for ratification at a general session of the approaching annual meeting for 1944, at Cleveland.

That recommendation was approved by the Council, but the proposed Fourth Constitution failed to receive a unanimous vote for ratification at the Cleveland general session when presented, although it received all but one of the votes that were recorded. It is therefore to be submitted again, this time to a general session at the next succeeding annual meeting, which will be the approaching St. Louis meeting. As before, it is to be proposed as an amendment to the present Third Constitution, which provides as follows:

> ARTICLE 11. ALTERATION OF THE CONSTITUTION. *This Constitution may be amended at a general session by unanimous vote or by a majority vote at two consecutive annual meetings.*

A majority vote of approval at St. Louis would complete the act of ratification, and the new Constitution would then become effective one month thereafter. The proposed revision includes numerous changes of wording and some changes in the general organization of the Association, and amendments adopted from time to time in the last twenty-five years are duly incorporated. The special committee expects to undertake a thorough revision of the By-laws and Rules of Procedure if the new Constitution is ratified.

The Proposed New Constitution

ARTICLE I—OBJECTS

The objects of the American Association for the Advancement of Science are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress. The Association is a nonprofit scientific and educational organization. It aims to conduct meetings and conferences of those interested in the various branches of science and education, to produce and distribute publications, to administer gifts and bequests as prescribed by the donors thereof, to provide support for research, to arrange awards for the accomplishment of scientific work, to cooperate with other organizations in the advancement of science and to engage in such other activities as shall have been authorized by the Council.

ARTICLE II—MEMBERS

Section 1. The membership of the Association shall consist of Annual Members, Life Members, Sustaining Members, Honorary Members and Emeritus Members. Admission to each of these five classes of membership shall be in accordance with the provision of Section 2 of this Article and with such relevant rules as the Council shall have prescribed. The Council may establish additional classes of membership.

Section 2. (a) *Annual Members.* Any person, institution or organization may be admitted to annual membership. Each Annual Member shall have such rights and privileges and shall pay such annual dues as the Council shall have prescribed.

(b) *Life Members.* Any person making to the Trust Funds of the Association a life-membership contribution of such amount as the Council shall have prescribed may be admitted to life membership. Each Life Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

(c) *Sustaining Members.* Any person making to the Trust Funds of the Association a sustaining-membership contribution of such amount as the Council shall have prescribed shall be the founder of a Sustaining Membership, which shall bear his name and shall be maintained in perpetuity as a trust. Each incumbent of a sustaining membership shall have all the privileges of a life member. The first incumbent of a sustaining membership may be either the founder himself or another person named by him, as he may choose. On the death or resignation of an incumbent, the Executive Committee shall name another person to hold the membership throughout life.

(d) *Honorary Members.* Any person may be admitted to honorary membership under such conditions as the Council shall have prescribed. Each Honorary Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

(e) *Emeritus Members.* Any individual annual member may be admitted to emeritus membership under such conditions as the Council shall have prescribed. Each Emeritus Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

Section 3. *Fellows.* Any person who shall have made a meritorious contribution to science may become a Fellow of the Association, under such procedures for nomination and election as the Council shall have prescribed.

ARTICLE III—OFFICERS

Section 1. The officers of the Association shall be (a) General Officers, elected from among the Fellows by ballot of the Council, and (b) Administrative Officers, elected by the Executive Committee as prescribed in Section 3 of this Article.

Section 2. *General Officers.* The general officers of the Association shall be a President Elect, a President, a Retiring President, and a Vice President for each Section. The term of office of the general officers shall be one year. The term of office of the President Elect and of the Vice Presidents shall begin on the January fifteenth following their election. At the close of the one-year term of the President Elect he shall become President, and at the close of the one-year term of the President he shall become Retiring President. In the event of a vacancy in the office of President, the President Elect shall become President. In the event of a vacancy in the office of President Elect, the Executive Committee shall make a *pro tempore* appointment to hold until the vacancy shall have been filled by ballot of the Council. In the event of a vacancy in the office of Vice President, the Executive Committee shall fill the vacancy by appointment.

Section 3. *Administrative Officers.* The administrative officers shall be an Administrative Secretary, an Assistant Administrative Secretary, a General Secretary, a Treasurer, and a Secretary of each Section. The term of office of each administrative officer shall be four years, or a shorter term if so determined by the Executive Committee. Unless otherwise determined at the time of his election, his term shall begin on the January fifteenth following his election. The Administrative Secretary, the Assistant Administrative Secretary, the General Secretary and the Treasurer shall be elected by the Executive Committee. The Secretaries of the Sections shall be nominated from among the Fellows by the respective Section

Committees and elected by the Executive Committee. In the event of a vacancy in the office of an administrative officer, the Executive Committee shall fill the vacancy for the remainder of the unexpired term. Additional administrative officers may be authorized by the Council, to be elected or appointed by the Executive Committee according to such rules and for such terms as the Council shall have determined in each instance.

ARTICLE IV—COUNCIL

Section 1. Control of all affairs of the Association is vested in the Council, which shall have power to review and to amend or rescind its own actions and all actions taken by the Executive Committee or by other agents to whom powers are delegated by this Constitution or shall have been delegated by the Council. The Council shall enact such bylaws as it may deem desirable, each of which shall remain in force until amended or rescinded by action of the Council.

Section 2. The Council shall consist of (a) the President Elect, the President, the Retiring President, the Vice Presidents, the Secretaries of the Sections, the Administrative Secretary, the General Secretary, the Treasurer and the eight elected members of the Executive Committee; (b) one Fellow elected by each regional Division of the Association; and (c) the representatives of affiliated organizations, as provided for in Article VII, Section 2, of this Constitution. Each Council member shall serve until his successor shall have taken office. The President shall be chairman of the Council; if the President shall be unable to serve as chairman at any session, the Council members in attendance shall elect a chairman for that session. Twenty members of the Council shall constitute a quorum for the transaction of business.

Section 3. There shall be an Executive Committee of the Council, which shall execute such commitments as the Council may direct and shall make recommendations to the Council. Subject to this Constitution, to the bylaws, and to specific actions by the Council, the Executive Committee shall have power to act for the Council when the Council is not in session. At each annual meeting of the Association the Executive Committee shall render to the Council a report on actions taken by the Committee for the Council. The Executive Committee shall consist of thirteen members: the President Elect, the President, the Retiring President, the Administrative Secretary, the General Secretary, and eight Fellows elected by ballot of the Council, two each year for a term of four years. At any election of members of the Executive Committee, not more than one Fellow serving his fourth consecutive year as an elected member may be re-elected. In the event of a vacancy in the office of an elected member of the Executive Committee, his successor for the remainder of the unexpired term shall be elected from among the Fellows by ballot of the Council at the next annual election. Six members of the Executive Committee shall constitute a quorum for the transaction of business. The Retiring President of the Association shall be chairman of the Executive Committee; if he shall be unable to serve at any session of the Committee, the Committee members in attendance shall elect a chairman for that session.

Section 4. There shall be a Finance Committee, consisting of the Treasurer, the Administrative Secretary, and four members elected by the Executive Committee, one each year for a term of four years. The Finance Committee shall advise the Treasurer regarding purchases and sales of securities for the Association. Upon request of the Executive Committee, the Finance Committee shall make recommendations to the Executive Committee regarding financial questions. The Finance Committee shall report its actions annually to the Executive Committee. The Chairman of the Finance Committee shall be one of its elected members, appointed by the Executive Committee to serve throughout his term of membership in the Finance Committee. Any vacancy in the Finance Committee shall be filled by the Executive Committee. Four members of the Finance Committee shall constitute a quorum for the transaction of business.

Section 5. The term of office of each of the eight elected members of the Executive Committee and of each of the four appointed members of the Finance Committee shall begin on the January fifteenth following his election or appointment, and each shall serve until his successor shall have taken office.

Section 6. The Council may establish additional committees, each of which shall include at least two members of the Council and shall stand until discharged. Such additional committees shall report to the Council at each annual meeting unless otherwise directed at the time of their establishment.

ARTICLE V—SECTIONS

Section 1. The Association shall consist of fifteen Sections, designated as follows: Mathematics (A), Physics (B), Chemistry (C), Astronomy (D), Geology and Geography (E), Zoological Sciences (F), Botanical Sciences (G), Anthropology (H), Psychology (I), Social and Economic Sciences (K); History and Philosophy of Science (L), Engineering (M), Medical Sciences (N), Agriculture (O), and Education (Q). Additional sections or subsections may be established by vote of the Council. Each member of the Association may designate the section in which he wishes to be enrolled and may designate one additional section in which he is interested.

Section 2. The Vice President for a Section shall be *ex officio* chairman of that Section.

Section 3. The affairs of each Section shall be managed by a Section Committee consisting of (a) the Chairman and the Secretary of the Section; (b) other members of the Council who are primarily enrolled in the Section; and (c) four Fellows, one elected each year by the Section Committee for a term of four years. No person shall serve concurrently in more than one Section Committee. If an elected member of a Section Committee shall have resigned or died, his successor for the remainder of the unexpired term shall be elected from among the Fellows by the Executive Committee, from nominations made by the Section Committee. One-third of the members of a Section Committee shall constitute a quorum for the transaction of business.

Section 4. The Section Committee of each Section shall promote the work of the Association in its own field and may organize subcommittees for that purpose. It shall arrange such section programs as it shall deem desirable for meetings of the Association, either separately or in cooperation with other sections of the Association or with independent societies. With the approval of the Executive Committee, a Section Committee may arrange section meetings to be held at places and times other than those of Association meetings.

ARTICLE VI—DIVISIONS AND BRANCHES

Section 1. Regional Divisions and Local Branches of the Association may be authorized by vote of the Council, for the purpose of promoting the work of the Association in their respective territories.

Section 2. Each Regional Division or Local Branch shall elect its officers for such terms as it shall prescribe and shall hold its meetings and conduct its affairs as it shall deem desirable, subject to the relevant provisions of this Constitution and of the Bylaws of the Association, and to such special provisions as the Council of the Association shall have established.

ARTICLE VII—AFFILIATED AND ASSOCIATED ORGANIZATIONS

Section 1. To facilitate cooperation between the Association and other organizations, and among the latter, the Council may elect an organization to be an officially affiliated or an officially associated academy or society.

Section 2. Each organization elected to be an Affiliated Society shall be entitled to name one Fellow of the Association to represent it in the Council; if it has more than one hundred members who are Fellows of the Association, it shall be entitled to name an additional Fellow of the Association to represent it in the Council.

ARTICLE VIII—MEETINGS

Section 1. The Association shall hold an annual meeting each year at such time and place as the Council shall have determined. Other meetings of the Association or of its sections may be authorized by the Council.

ARTICLE IX—PUBLICATIONS

Section 1. Summarized Proceedings of the Association and Directories of its Officers and Members shall be published at such times and in such manner as the Council shall have directed. By authorization of the Council, the Association may arrange for the production and distribution of journals, books, and other publications.

ARTICLE X—FUNDS

Section 1. Funds of the Association shall be classified as Current Funds, Investment Funds, and Trust Funds.

(a) *Current Funds* shall include all dues of annual members, all receipts from publications and all other funds received in the continuing operations of the Association.

(b) *Investment Funds* shall include all gifts and bequests received without special restriction concerning the use to be made of principal and income, and all other funds designated by the Council as investment funds. Investment Funds shall be invested in securities or other properties or held in cash while awaiting investment. Both principal and income of Investment Funds may be used for any purpose, but only after specific appropriations by the Council.

(c) *Trust Funds* shall consist of all life-membership contributions, all sustaining-membership contributions, all funds appropriated by the Council for establishing special life memberships, all gifts and bequests accepted with specific restrictions prohibiting their allotment to either Current Funds or Investment Funds, and all other funds designated by the Council as Trust Funds. Trust funds shall be invested in securities or other income-producing properties, or held in cash while awaiting investment. The principal of every trust fund shall be maintained in perpetuity unless otherwise originally provided by the donor thereof or by the Council. Income from any trust fund shall be used only after special appropriation by the Council. Income from trust funds received as gifts or bequests may be appropriated only for purposes prescribed by the donors thereof, and income from other trust funds, except individual life-membership contributions while the contributors thereof are living, may be appropriated only for the support of research unless otherwise prescribed by the Council when the funds were established. It is provided that income from individual life-membership contributions may be appropriated by the Council for any purpose so long as the respective contributors are living.

Section 2. The Administrative Secretary shall be custodian of all Current Funds, which he shall collect and disburse under the direction of the Executive Committee. He shall collect life-membership and sustaining-membership contributions and shall transfer them to the Treasurer for allocation to Trust Funds. Every check issued by the office of the Administrative Secretary shall bear two signatures, those of the Administrative Secretary and the Assistant Administrative Secretary or those of the Treasurer and either the Administrative Secretary or the Assistant Administrative Secretary. The Administrative Secretary, the Assistant Administrative Secretary and the Treasurer shall be bonded in favor of the Association for such amounts as the Executive Committee shall have determined.

Section 3. The Treasurer shall be custodian of all Investment Funds, all Trust Funds, and all other funds placed in his charge by action of the Council. He shall administer gifts and bequests in accordance with such provisions as shall have been made by the donors thereof. Unless otherwise directed by the Council, he shall sell securities from the investment portfolio of the Association, and purchase securities for the investment portfolio, in accordance with such advice of the Finance Committee as shall have been formally recorded in the minutes of its meetings. He shall collect the income of all funds in his charge and shall dispose of it as directed by the Council. Every check issued by the office of the Treasurer shall bear two signatures, that of either the Treasurer or the Chairman of the Finance Committee and that of either the Administrative Secretary or the Assistant Administrative Secretary.

Article XI—Ratification and Amendments

Section 1. This Constitution shall become effective one month after it shall have been ratified in accordance with the procedure established for amending the Constitution of 1919. It shall invalidate the Constitution of 1919 and all amendments thereto.

Section 2. To become effective, any proposed amendment to this Constitution shall be approved by the Executive Committee, published in the official journal of the Association at least one month prior to an annual meeting of the Association, and ratified either (a) by a nine-tenths vote of the Council members present in a Council session of that meeting or (b) by a two-thirds vote of the Council members present in each of two Council sessions held at consecutive annual meetings of the Association. Ratified amendments shall be published promptly in the official journal of the Association and shall become effective one month after ratification.

The Present Constitution

In force since January 3, 1920[1]

Article 1—Objects

The objects of the Association are to promote intercourse among those who are cultivating science in different parts of America, to cooperate with other scientific societies and institutions, to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and a wider usefulness.

Article 2—Membership

Persons willing to cooperate in the work of the Association may be elected to be members by the Council. Members who are professionally engaged in scientific work or who have advanced science by research may be elected to be fellows. *The Council shall fix the admission fees and dues (Dec. 27, 1934).* A member who pays at one time the sum of one hundred dollars to the Association becomes a life member and is exempt from further dues. A person who gives one thousand dollars to the Association may be elected to be a sustaining member and is exempt from further dues.

Article 3—Officers

The officers of the Association shall be elected by ballot by the Council, and shall consist of a President, a Vice President from each Section, a Permanent Secretary, a General Secretary, a Treasurer and a Secretary of each Section. The President and the Vice Presidents shall be elected for one year, the other officers for four years. The officers shall perform the usual duties of these offices, under the direction of the Council.

Article 4—Council

The Council shall consist of the President, the Vice Presidents, the Permanent Secretary, the General Secretary, the Secretaries of the Sections, and the Treasurer, *the members of the Executive Committee, ex officio, if they are not otherwise members of the Council (Dec. 27, 1923)*, of one fellow elected by each *division, affiliated state academy, and (Dec. 27, 1932)* affiliated society, and one additional fellow from each affiliated society having more than 100 members who are fellows of the Association, and of eight fellows, two elected annually by the Council for a term of four years. There shall be an Executive Committee of the Council, consisting of the President, the Permanent Secretary, the General Secretary and eight members elected by the Council, two annually for a term of four years, who shall be *ex officio* members of the Council. The Council may appoint standing or temporary committees to make reports, to assist in the conduct of the work of the Association and to promote its objects.

Article 5—Sections

The Association shall be divided into the following Sections: A, Mathematics; B, Physics; C, Chemistry; D, Astronomy; E, Geology and Geography; F, Zoological Sciences; G, Botanical Sciences; H, Anthropology; I, Psychology; K, Social and Economic Sciences; L, Historical and Philological Sciences; M, Engineering; N, Medical Sciences; O, Agriculture; P, *Industrial Science (Dec. 28, 1936)*; Q, Education. Members of the Association shall be members of that Section or of those Sections under which their work or their interests fall. Members of the Section shall nominate to the Council a Chairman, who becomes *ex officio* a Vice President of the Association and whose term of office shall be one year, and a Secretary, whose term of office shall be four years. These officers, together with four fellows, one elected annually by the Section for a term of four years, and the representatives on the Council of affiliated societies in the same field shall form a Sectional Committee. This Committee shall arrange the scientific programs of the meetings and may form sub-sections or hold joint meetings with other sections or other societies. It may appoint committees and shall in all ways promote the objects of the Association within its own field.

Article 6—Divisions and Branches

Regional Divisions and Local Branches of the Association may be formed by vote of the Council. Such Divisions and Branches may elect officers, hold meetings, appoint committees, enter into relations with other societies and promote within their fields the objects of the Association.

Article 7—Associated and Affiliated Societies

National and local scientific societies may by vote of the Council, become associated with the Association. Those Associated Societies which the Council shall designate as Affiliated Societies shall be represented on the Council and on the Sectional Committees as provided in Articles 4 and 5.

---

[1] From Summarized Proceedings, 1934–40, pages 61, 62. Amendments adopted since 1920 are shown in italics, with dates of their adoption in parentheses.

ARTICLE 8—MEETINGS

The Association shall hold an annual meeting at such time and place as may be determined by the Council. Other meetings of the Association and of the Sections may be authorized by the Council. The Divisions and the Branches may hold annual and other meetings.

ARTICLE 9—PROCEEDINGS

The proceedings of the Association and the list of officers and members shall be published in such manner as the Council may direct.

ARTICLE 10—FUNDS

The Permanent Secretary shall collect the annual dues and make expenditures as directed by the Council. The Treasurer shall deposit or invest the permanent funds of the Association, as provided for trust funds by the laws of the state of Massachusetts or the state of New York. Bequests and gifts will be administered in accordance with the provisions of the donors. The payments from sustaining and life members form part of the permanent fund, and the income (after the death of the member) shall be used for research, unless otherwise directed by unanimous vote of the Council or by a majority vote at two consecutive annual meetings.

ARTICLE 11—ALTERATION OF THE CONSTITUTION

This Constitution may be amended at a general session by unanimous vote or by a majority vote at two consecutive annual meetings.

Audit of Financial Records of the Association for 1944

F. R. Moulton
Permanent Secretary, AAAS, Washington, D.C.

Demands on certified accountants for reports of financial operations related to the war and income taxes have been so heavy that only on 21 January 1946 did the Association receive the report of the audit of its books for the calendar year 1944, which is printed in full below. In recent months conditions have improved and it is expected that the audit of the books of the Association for 1945 will be started in April or May 1946.

In reading the following report of the audit of the books of the Association by G. P. Graham & Company, certified public accountants, it will be well to bear in mind that the endowments and other permanent funds of the Association are in the Treasurer's account and almost completely independent of the general operations of the Association. The audit of the general operations of the Association is presented under the heading "Office of the Permanent Secretary." This is the part of the report that will be of greatest interest to most members and it can be read understandingly quite independently of what precedes it.

The first tabulation in both the Treasurer's accounts and those of the Office of the Permanent Secretary is the Balance Sheet, which presents in clear and condensed form the condition of the respective accounts at the close of the year. The statement of Income and Expense in the report on the Office of the Permanent Secretary is a concise statement of the financial operations of the general offices of the Association during the calendar year 1944. The "Comments" which precede the auditor's principal tabular reports contain important supplementary information about the financial operations of *The Scientific Monthly*, the payments toward the purchase of *Science,* and the AAAS-Gibson Island Research Conferences.

January 21, 1946

The American Association for the
Advancement of Science
Washington, D. C.

We have audited the financial records of your Treasurer's office and of your Permanent Secretary's office for the year ended December 31, 1944, and submit herewith our report consisting of exhibits and schedules (A–G) together with comments thereon.

COMMENTS

The accounting records of the American Association for the Advancement of Science are kept at the general offices of the Association in the Smithsonian Institution Building, Washington, D. C., and consist of two separate sets of accounts. The records relating to the Treasurer's office include the details of all investments owned by the Association, income received therefrom, the disbursement of such income and a complete record of all endowment funds of the Association. Certain funds of the AAAS-Gibson Island research conferences are handled through the Treasurer's cash records but for the purposes of this report these items are shown separately.

The accounts of the Permanent Secretary's office reflect the general operations of the Association and include the record of membership dues paid, sales of publications and expenditures authorized by the Council or Executive Committee.

Treasurer's Accounts

The cash balances recorded in the Treasurer's accounts were carried with the following banks located in the District of Columbia:

American Security and Trust Company		
Checking account	$30,117.21	
Less: Funds of AAAS-Gibson Island research conferences	6,329.32	$23,787.89
Savings account		7,500.00
Hamilton National Bank		
Savings account		1,500.00
Washington Loan and Trust Company		
Savings account		2,500.00
		$35,287.89

Securities owned by the Association are listed in detail in Schedule B–1. Separate investment accounts are not carried for the individual endowment and reserve funds of the Association, but all investments are pooled into one account and the total income received is apportioned to the various funds on the basis of its total investment in the pool account.

During the year under review income received from investments amounted to $4,832.61 and was apportioned as follows:

For general purposes	$1,736.36
For research	2,139.40
A. G. Stillhamer fund	65.24
Jane M. Smith fund	92.30
Luella A. Owen fund	9.18
Treasurer's reserve fund	790.13
	$4,832.61

Ordinarily the Treasurer's reserve fund account is adjusted to reflect the losses or gains from sales of securities, but where particular securities were received as a part of a fund, the principal of the fund has been adjusted to reflect the gain or loss from the disposition of such securities. During the year under review the Hector E. Maiben fund was increased by $3,498.58 representing the excess of the amounts received from the D. F. Schwegman and Otto Balz notes over the amounts at which they were carried on the books.

Other changes in endowment and reserve funds during the year were as follows:

Treasurer's reserve fund		
Balance January 1, 1944		$42,782.71
Add: Income apportionment		790.13
		$43,572.84
Deduct: Net loss on securities		6,303.53
Balance December 31, 1944		$37,269.31
Fees of deceased life members		
Balance January 1, 1944		$21,650.00
Add: Fees of regular life members who died during year		1,150.00
Balance December 31, 1944		$22,800.00
Fees of living life members		
Balance January 1, 1944		$47,850.00
Add: Fees received during year		3,500.00
		$51,350.00
Deduct: Fees of deceased life members		
Regular—Transferred to fees of deceased life members	$1,150.00	
Emeritus—Transferred to income account of Jane M. Smith fund and made available for creation of new emeritus life memberships	1,400.00	2,550.00
Balance December 31, 1944		$48,800.00
Friends of the Association		
Balance January 1, 1944		$ 3,559.00
Add: Gift of John S. Wright		100.00
Balance December 31, 1944		$ 3,659.00

There were no changes in the prize fund during the year. This fund represents amounts contributed for the thousand dollar prize.

The academy grants unpaid include the balances of grants made for the years 1941, 1942, 1943 and 1944 which were not paid as at December 31, 1944. These balances may be summarized by years as follows:

1941	$ 92.94
1942	267.00
1943	648.00
1944	1,255.00
Total	$2,262.94

The special research fund represents an amount received from Dr. Elihu Grant in 1941 for research work and which was unexpended as at December 31, 1944.

Accumulated income unappropriated as at December 31, 1944, included income received from investments during the year under review which was available for research and for general purposes in the fiscal year 1945; unexpended balance of previous years, the total of which is available at any time;

and the accumulated income of restricted funds which is available for the following purposes:

Jane M. Smith fund—For emeritus life members
Luella A. Owen fund—For emeritus annual members
A. G. Stillhamer fund—For grants in biology

On January 1, 1944, the unexpended balances of previous years amounted to			$6,770.22
To this has been added the excess of revenue over expenditures for the year ending December 31, 1944, determined as follows:			
Income available for research and for general purposes		$2,985.98	
Less: Academy research grants	$2,538.50		
General expense	24.00	2,562.50	423.48
making a total unexpended balance available as at December 31, 1944, amounting to			$7,193.70

Permanent Secretary's Accounts

The cash in banks as recorded on the accounts of the Permanent Secretary were as follows:

American Security and Trust Company	
Checking account	$153,465.09
Savings account	26,256.22
	$179,721.31

Accounts receivable as at December 31, 1944, included amounts due for the following:

Scientific Monthly advertising	$ 100.68
Science advertising	10,147.19
Science nonmember subscriptions	4,220.77
	$14,468.64

Inventories of supplies on hand were made under the supervision of officers of the Association and were not verified by us.

Deferred charges include expenses of $2,517.02 incurred in preparing certain invitations to prospective members which will be charged in 1945, and the net expense of the Science series publications to December 31, 1944.

Accounts payable as at December 31, 1944, represented the following:

Scientific Monthly expense	$ 4,392.03
Science expense	5,578.00
Bulletin	602.60
1944 inflation allowance on annuity	4,165.00
Miscellaneous expense	271.84
	$15,009.47

As at January 1, 1944, life membership fees received by the Permanent Secretary and not remitted to the Treasurer amounted to	$2,100.00
Fees received during the year 1944 were	3,900.00
A total of	$6,000.00
Remittances made to the Treasurer during 1944 amounted to	3,500.00
leaving a balance due to the Treasurer as at December 31, 1944, in the amount of	$2,500.00

Deferred income includes amounts received from members for dues and fees for years subsequent to 1944 and for prepaid 1945 journal subscriptions.

The summarized proceedings reserve represents the amounts received from sales of the proceedings, together with funds provided in prior years for publication costs, less amounts expended for publication and distribution of the proceedings.

The reserve for symposia publications is the excess of the total amount received from the sales of the publication over the disbursements for publication costs, distribution and other expenses. These receipts and disbursements are not included in the statement of income and expenses of the Permanent Secretary's office.

Unallocated funds of the Permanent Secretary's office represents the general surplus of the Association. An analysis of this account for the year under review is shown in Exhibit A.

The indenture referred to sets forth the manner in which the amount of the annuity payments over a period of ten years and the inflation allowances thereon would be determined. As at December 31, 1944, the exact amount of the annuity had not been determined and the amounts paid during 1944 were based on amounts agreed to in a supplemental agreement which further provided that the amount paid in 1944 would be adjusted after final determination had been made as to the amount of the annuity payments.

Amounts paid or accrued in 1944 on the annuity and the inflation allowance amounted to		$21,165.00
and the correct amounts due were as follows:		
Annuity payment	$15,718.42	
Inflation allowance	3,851.02	19,569.44
The 1944 overpayment of		$ 1,595.56

was deducted from the 1945 annuity payments.

The total amount payable on the annuity was determined to be $166,430.69 and to the amounts payable each year will be added any amount which may be due under the inflation clause as set forth in the original indenture dated December 12, 1938.

In 1943 the Association purchased the journal *The Scientific Monthly* for a cash payment of $9,499.59

and the books of the Association do not reflect the value of that journal nor the value of the journal *Science* which was acquired in 1944. No liability has been set up for the additional amounts payable on the annuity.

As at December 31, 1944, claims of Mr. Ware Cattell and Dr. Charles S. Stephenson were pending against the Association. In January, 1945, Mr. Cattell was paid $7,500.00 from unallocated funds of the Permanent Secretary in full settlement of his claim. We have been advised that the amount of the liability, if any, under the claim of Dr. Stephenson has not been determined.

AAAS-Gibson Island Research Conferences

The Association owns certain property on Gibson Island, Maryland, which was acquired in 1941 and is used for summer conferences. The cost of this property and subsequent additions and improvements was paid from funds contributed to the Association for that purpose and none of the general funds of the Association have been used on this project. A balance sheet of the AAAS-Gibson Island research conferences as at December 31, 1944, is shown (Exhibit F) and there is a statement of income and expense for the year ended December 31, 1944 (Exhibit G).

As previously stated certain funds of the AAAS—Gibson Island research conferences are handled through the Treasurer's account, and the cash in bank as shown on the balance sheet was on deposit in that account on December 31, 1944. However, the actual receipt of income and certain of the disbursements were handled by the Director at Gibson Island and the remaining balance was deposited in the Treasurer's account. The statement of income and expense set forth (Exhibit G) was prepared from statements submitted by the Director of amounts received and disbursed by him together with amounts disbursed from the Treasurer's account.

General

The cash balances as shown were reconciled with statements submitted by the various depositories. The securities owned by the Association are carried in a safe deposit box at the American Security and Trust Company and were inspected by us subsequent to December 31, 1944. All changes in securities since the above date have been reviewed by us and the securities which were on hand December 31, 1944, have been properly accounted for.

During the course of the audit we examined or tested the accounting records and other supporting evidence by methods and to the extent we deemed appropriate, but did not make a detailed audit of the transactions.

Subject to the above comments, we are of the opinion that the statements present fairly the financial condition of the American Association for the Advancement of Science as at December 31, 1944, and the results of its operations for the year ended on that date.

Respectfully submitted,

G. P. GRAHAM & COMPANY
Certified Public Accountants

Washington, D. C.

Appendix

Exhibit A

Balance as at January 1, 1944			$29,482.18
Add:			
Excess of income over expenses for year (See *Exhibit E*)			57,760.95
			$87,243.13
Deduct:			
Amounts paid or accrued in 1944 under indenture dated December 12, 1938, providing for purchase of the journal *Science*			
Annuity payments January 20 to December 31, 1944	$17,000.00		
Inflation allowance on annuity	4,165.00		
Adjustments of 1944 subscriptions to *Science*	19,675.91	$40,840.91	
Prior year adjustment		8.00	40,848.91
Balance as at December 31, 1944			$46,394.22

Exhibit B

TREASURER'S ACCOUNTS

Balance Sheet as at December 31, 1944

Assets

Endowment and reserve funds			
Cash awaiting investment		$ 18,108.22	
Securities		243,720.21	$261,828.43
Cash for current purposes			17,179.67
			$279,008.10

Liabilities and Reserves

Endowment and reserve funds			
For research			
Richard T. Colburn fund	$87,186.45		
Fees of deceased sustaining members	7,000.00		
Fees of deceased life members	22,800.00	$116,986.45	
For general purposes			
W. Hudson Stephens fund	$ 4,381.21		
Michael P. Rich fund	10,000.00		
Hector E. Maiben fund	30,707.46		
Friends of the Association	3,659.00		
Jennie M. Arms—Sheldon fund	1,000.00		
Fees of living life members	48,800.00	98,547.67	
For special purposes			
Jane M. Smith fund	$ 5,000.00		
Luella A. Owen fund	500.00		
A. G. Stillhamer fund	3,525.00	9,025.00	
Treasurer's reserve fund		37,269.31	$261,828.43
Current liabilities			
Prize fund	$ 2,000.00		
Academy grants	2,262.94		
Special reserve fund	100.00	$ 4,362.94	
Accumulated income unappropriated			
For research	$ 2,139.40		
For general purposes	1,736.36		
Jane M. Smith fund	1,525.30		
Luella A. Owen fund	10.58		
A. G. Stillhamer fund	211.39		
Unexpended balances of previous years	7,193.70	12,816.73	17,179.67
			$279,008.10

Schedule B-1

Statement of Securities Owned as at December 31, 1944

	Book Value
United States bonds	
$10,000 U. S. Savings, Series D, Feb., 1950	$ 8,300.00
40,000 U. S. Savings, Series F, June, 1954	29,960.00
50,000 U. S. Treasury ⅞% Certificates, Feb., 1945	50,000.00
40,000 U. S. Treasury ⅞% Certificates, June, 1945	40,000.00
10,000 U. S. Treasury ⅞% Certificates, Dec., 1945	10,000.00
40,000 U. S. Treasury 2% 1952/54	40,000.00
Other bonds	
$42,000 Pittsburgh, Shawmut and Northern Railroad 4% 1952	4,200.00
2,805 Nebraska State Fair Grand Stand Debentures 5% 1939	2,812.50
Stocks	
50 Sh. Eastman Kodak Company	8,455.59
100 Sh. General Motors Corporation	4,415.92
100 Sh. International Harvester Company	5,920.42
100 Sh. G. C. Murphy Company—4¾% Preferred	10,500.00
100 Sh. Procter and Gamble Company	4,955.01
200 Sh. Standard Oil Company of Indiana	5,586.25
100 Sh. Swift and Company	2,309.62
100 Sh. United Fruit Company	7,725.89
100 Sh. Wm. Wrigley, Jr., Company	6,785.51
Mortgage participation certificates	
$1,000 Sigma Phi Epsilon Building Association	982.50
1,000 Edward Mackey	811.00
	$243,720.21

(Continued, column 2)

Exhibit C

TREASURER'S ACCOUNTS

Statement of Receipts and Disbursements
Year Ended December 31, 1944

Cash balances January 1, 1944		$111,586.35
Receipts		
Interest and dividends received	$ 4,832.61	
Contributions for grants to academies	300.00	
Sale and redemption of securities	74,295.47	
Gift from John S. Wright for endowment fund	100.00	
Life membership fees	3,500.00	83,028.08
		$194,614.43
Disbursements		
Grants		
Academy research grants	$ 1,651.06	
Grants from contributions	300.00	
Miscellaneous expenses	24.00	
Securities purchased	157,351.48	159,326.54
Cash balances December 31, 1944		
For investment	$ 18,108.22	
For current purposes	17,179.67	$ 35,287.89

Exhibit D

OFFICE OF THE PERMANENT SECRETARY

Balance Sheet as at December 31, 1944

Assets

Current assets			
Cash in banks		$179,721.31	
Accounts receivable		14,468.64	
Inventories of supplies			
Office supplies	$ 50.00		
Postage	1,182.46		
Printing and stationery	771.34	2,003.80	196,193.75
Deferred charges			
Circularization		$ 2,517.02	
Science series publications (Net)		462.73	2,979.75
			$199,173.50

Liabilities

Current liabilities			
Accounts payable		$ 15,009.47	
Treasurer's account (Life membership fees)		2,500.00	$ 17,509.47
Deferred income			
Prepaid dues and fees		$108,210.25	
Prepaid subscriptions—1945			
Science—Special membership subscriptions	$ 1,119.00		
The Scientific Monthly			
Special membership subscriptions	3,540.00		
Nonmember subscriptions	7,348.36	12,007.36	120,217.61
Reserves			
Summarized proceedings		$ 5,611.90	
Symposia publications		9,440.30	15,052.20
Unallocated funds			46,394.22
			$199,173.50

Exhibit E

OFFICE OF THE PERMANENT SECRETARY

Statement of Income and Expense for the Year Ended December 31, 1944

Income

Dues of annual members			
Current year	$118,085.00		
Arrearages for one year	1,135.00		
Other arrearages	220.00	$119,440.00	
Entrance fees		35.00	
Interest on bank accounts		143.15	
Journal subscriptions (from Treasurer)			
Life members	$ 1,656.00		
Fifty-year members	63.00		
Emeritus annual members	21.00	1,740.00	$121,358.15

Expenses

Office of the Permanent Secretary			
Salaries	$ 23,765.83		
Office and addressograph supplies	245.01		
Postage	2,043.53		
Printing and stationery	1,278.45		
Telephone and telegraph	193.24		
Exchange on foreign checks	163.12		
Express, freight and drayage	8.93		
Miscellaneous expenses	666.09	$ 28,364.20	
General Secretary's office		326.82	
Bulletin		3,556.90	
Circularization		3,166.31	
Allowances to divisions		3,277.00	
Secretaries' conferences		703.04	
Cleveland meeting		3,217.07	
Travel expenses		827.54	
Journals			
The Scientific Monthly (See Schedule E-1)	$ 20,580.37		
Science (See Schedule E-2)	– 422.05	20,158.32	63,597.20
Excess of income over expenses			$ 57,760.95

Schedule E-1

THE SCIENTIFIC MONTHLY

Statement of Income and Expense for the Year Ended December 31, 1944

Income

Advertising		$ 3,405.89	
Special membership subscriptions		3,505.00	
Nonmember subscriptions		10,320.43	
Miscellaneous sales		972.10	$ 18,203.42

Expenses

Printing, binding and mailing	$24,771.22		
Authors' reprints	769.31		
Copyrights	22.00		
Photographs and engravings	13.92	$ 25,576.45	
Salaries	$ 8,164.79		
Postage	93.61		
Stationery and supplies	178.84		
Telephone and telegraph	155.06		
Express	18.67		
Travel	5.19		
Binding volumes	142.50		
Subject file of articles published	72.90		
Miscellaneous expenses	50.60	8,882.16	
Subscription clerical expense		1,574.48	
Subscription service at Science Press		2,393.62	
Requests to members for back numbers		357.08	38,783.79
Excess of expenses over income			$ 20,580.37

Schedule E-2

SCIENCE

Statement of Income and Expense for the Year Ended December 31, 1944

Income

Advertising		$ 56,887.23	
Special membership subscriptions		1,122.00	
Nonmember subscriptions		16,042.46	
Miscellaneous sales		28.10	$ 74,079.79

Expenses

Printing, binding and mailing	$50,871.14		
Salaries	6,366.76		
Advertising expenses (Washington office)	1,644.05		
Furniture and equipment	1,041.24		
Books	58.66		
Express	2.00		
Binding volumes	18.50		
Travel expense	70.03	$ 60,072.38	
Services of Science Press			
Editorial			
Salaries	$ 2,592.28		
Other expenses	175.88		
Subscription			
Salaries	6,311.78		
Other expenses	145.08		
Advertising			
Salaries	2,352.41		
Other expenses	261.03		
Postage and supplies	545.32		
Rent	803.16		
Miscellaneous news services	167.75		
A. B. C. audits	173.67		
National Publishing Association	57.00	13,585.36	73,657.74
Excess of income over expenses			$ 422.05

Exhibit F

AAAS–GIBSON ISLAND RESEARCH CONFERENCES

Balance Sheet as at December 31, 1944

Assets

Current assets			
Cash in bank		$ 6,329.32	
Imprest fund		212.00	$ 6,541.32
Fixed assets			
Land		$ 7,000.00	
Building	$21,947.60		
Less: Reserve for depreciation	1,097.38	20,850.22	
Furniture and equipment	$ 5,582.61		
Less: Reserve for depreciation	558.26	5,024.35	
Library		763.50	33,638.07
Deferred charge			
Prepaid insurance			318.40
			$ 40,497.79

Liabilities

Reserved for Gibson Island maintenance and water tax	$ 100.00
Operating fund	6,897.79
Library fund	500.00
Trust fund	33,000.00
	$ 40,497.79

Exhibit G

AAAS–Gibson Island Research Conferences

Statement of Income and Expense for the Year Ended December 31, 1944

Income			
Registration fees		$ 2,256.00	
Room rentals		5,939.69	
Telephone receipts		89.19	$ 8,284.88
Expenses			
Secretarial assistance		$ 445.20	
Postage and supplies		158.83	
Railroad fares		191.79	
Board for employees		385.00	
Telephone		194.27	
Water		63.54	
Electricity and gas		24.31	
Express and hauling		13.12	
Laundry		316.08	
Library		28.80	
Housecleaning		600.70	
Household furnishings		326.57	
Repairs		176.44	
Coal		26.68	
Badges		15.17	
Gibson Island maintenance tax		76.23	
Director's expense		392.55	
Director's honorarium		1,200.00	
Miscellaneous		102.16	
Depreciation			
Buildings	$ 1,097.38		
Furniture and equipment	558.26	1,655.64	
Provision for insurance		100.00	
Reserved for Gibson Island maintenance and water tax		100.00	6,593.08
Excess of income over expenses			$ 1,691.80

Program Ninth AAAS-Gibson Island Conference

17 June—24 August

Frontiers in Chemistry

Sumner B. Twiss, Director

PETROLEUM CHEMISTRY

S. S. Kurtz, Jr., Chairman; P. D. Bartlett, Vice-Chairman

17 June E. Bright Wilson, Jr., "Infrared and Raman Spectra." R. S. Mulliken, "Ultraviolet Absorption Spectra."

18 June G. W. Wheland, "Theory of the Chemical Bond and Resonance in Hydrocarbons." P. D. Bartlett, "Report of Committee on Future Policy of Conference on Petroleum Chemistry at Gibson Island." L. S. Kassel, "Isomerization Equilibria in High Molecular Weight Paraffins." *Discussion invited.*

19 June Henry Eyring, "Theory of Viscosity of Hydrocarbons." R. W. Schiessler, "Correlation of Structure With Physical Properties of Heavy Hydrocarbons."

20 June A. Farkas, "Use of Stable Isotopic Tracer Elements in Chemical Research." G. T. Seaborg, "Use of Radioactive Tracers in Chemical Research."

21 June O. Beeck, "Recent Developments in Spectrochemical Analysis."

CATALYSIS

H. H. Storch, Chairman; W. G. Frankenburg, Vice-Chairman

24 June Frederick Seitz, "Crystal Growth and Factors Influencing Catalysis." A. T. Gwathmey, "The Directional Surface Properties of Single Crystals of Metals."

25 June J. A. Becker, Informal Round Table Discussion, "Adsorption of Alkalies on Metals, Its Effect on Electron Emission, and Application to Contact Catalytic Reactions." Ahlborn Wheeler, "Determination of Pore-size Distribution in Solid Catalysts."

26 June Howard L. Ritter, "Some Experimental Methods in the Determination of Pore-size Distributions." Thomas D. DeWitt, "A Critical Review of the Present Status of Multilayer Adsorption Theory." Robert B. Anderson, "Surface Area Measurements and Chemi-sorption of Carbon Monoxide on Fischer-Tropsch Catalysts."

27 June L. J. E. Hofer, "The Activity of Fischer-Tropsch Iron Catalysts as a Function of the Crystal Structure and Magnetic Properties of the Unconditioned Catalysts." W. A. Horne, "Catalysts in German Synthetic Fuel Industry." B. B. Corson, "Catalytic Alkylation and Dealkylation of Aromatics."

28 June Herbert C. Brown, "A Theory of Hydrocarbon Isomerization in Homogeneous Systems."

ORGANIC HIGH POLYMERS

C. S. Fuller, Chairman; C. C. Price, Vice-Chairman

1 July F. R. Mayo, "Copolymerization." P. D. Bartlett, "The Rate of the Steps in Vinyl Polymerization."

2 July Symposium on the Present Status of Molecular Weight Methods: F. T. Wall, "Osmotic Pressure." P. M. Doty, "Light Scattering." J. B. Nichols, "Ultracentrifuge." R. H. Ewart, "Viscosity." D. R. Morey, "Some Precipitation and Fractionation Phenomena as Related to Molecular Weights." H. M. Spurlin, "Effect of Association in Solution on Molecular Weight Results."

3 July W. H. Stockmayer, "Effects of Branching on Thermodynamic and Transport Properties of Polymer Solutions." L. R. Treloar, subject to be announced later.

4 July W. O. Baker, "Structure of Synthetic Rubber." W. B. Reynolds, "Some Observations on the Functions of Emulsifiers, Promoters and Modifiers in Emulsion Polymerization Reactions."

5 July P. J. Flory, "Physical Properties in Relation to Structure of Vulcanized Rubber."

TEXTILES

D. H. Powers, Chairman; W. A. Sisson, Vice-Chairman

8 July Ross Whitman, "Curl in Woven Textile Fabrics: Its Cause and Control." Stanley Backer, "The Relation of Fiber and Fabric Structure to Wear Resistance and Durability."

9 July C. L. Mantell, "Some Notes on Cellulose Solvents and Their Application to Special Textile Finishes." F. T. Peirce, "Cloth Geometry and Its Application to Functional Design."

10 July H. W. Mohrman and R. J. Schatz, "The Effect of Textile Sizing Agents Upon the Physical Properties of Cotton Fabric Laminates." M. T. O'Shaughnessy and L. G. Ray, "Tensile and Torsional Properties of Textile Fibers."

11 July W. J. Hamburger, "Load-Deflection-Time Relationships in Textiles." H. Mark, "Structural Principles for Resiliency and Recovery in Fibers."

12 July S. Coppick, R. W. Little, and J. H. Church, "Chemical Behavior of Cellulose Under Influence of Retardants at Combustion Temperatures."

CORROSION

H. H. Uhlig, Chairman; K. G. Compton, Vice-Chairman

15 July W. E. Campbell, "The Electrolytic Theory of Oxidation and Tarnish." J. B. Austin, "Fundamental Factors in the Oxidation of Metals and Alloys."

16 July Oscar E. Harder, "Alloy Compositions for High Temperature Applications." S. D. Heron, "Stress Corrosion of Materials Exposed to Gasoline Combustion Products."

17 July F. N. Rhines, "Internal Oxidation." Harry K. Ihrig, "Alternate Oxidation and Carburization."

18 July Marshall H. Brown, "Corrosion by Chlorine and Hydrogen Chloride at High Temperatures." Aaron Wachter, "Hydrogen Attack on Metals at High Temperatures and Pressures."

19 July G. A. Hawkins, "Corrosion by High Temperature Steam." W. O. Binder, "Recent Trends in Alloys for High Temperature Service."

MEDICINAL CHEMISTRY

H. A. Shonle, Chairman; E. H. Northey, Vice-Chairman

22 July Speakers to be announced later, "Hypertension."

23 July John Lee, Glenn E. Ullyot, Edwin Fellows, Claude Winder, "Analgesics: Synthesis and Screening Tests."

24 July Speakers to be announced later, "Antibiotics."

25 July Antimalarials: Chemical Aspects. Robert C. Elderfield, "Review of the Chemistry of Recent Antimalarial Drugs Synthesized in the USA." Kenneth C. Blanchard, "Review of Foreign Progress on Antimalarials." Jackson P. English, "Metachloridine and Related Compounds."

26 July Antimalarials: Medicinal Aspects. James A. Shannon, "Clinical Evaluation." Richard S. Porter, "Screening Tests." L. H. Schmidt, "Pharmacology."

VITAMINS

N. B. Guerrant, Chairman; D. W. Woolley, Vice-Chairman

29 July F. P. Zscheile, "Recent Developments in Carotene Research." G. W. Kidder, "Growth Factors Required by Protozoa." C. I. Bliss, "The Design and Analysis of Experiments for Measuring Vitamin Potency."

30 July E. L. R. Stokstad and B. L. Hutchings, "Chemistry and Biological Function of Folic Acid." Paul Day, "Studies on the Nutrition of the Monkey, With Special Reference to the *Lactobacillus casei* Factor (Factor M, Factor Bc)." William J. Darby, "The Response of Sprue and Pernicious Anemia to the Administration of Synthetic *L. casei* Factor (Vitamin M, Folic Acid)."

31 July B. Connor Johnson, "The Metabolites of Nicotinic Acid and Nicotinamide in Human and Swine Nutrition." W. A. Krehl and C. A. Elvehjem, "Niacin and Tryptophane Relationship."

1 August J. A. Reyniers, "Germ-free Life as Applied to Nutrition Studies." L. B. Pett, "Some Public Health Aspects of Malnutrition." D. W. Woolley, "Vitamin Antagonists."

2 August Ancel Keys and Olaf Mickelson, "The Relation in Man Between Intake and Urinary Excretion of Thiamine and Riboflavin as Affected by Activity."

FOOD AND NUTRITION

H. J. Almquist, Chairman; Lawrence Atkin, Vice-Chairman

5 August David M. Greenberg, "The Dynamics of Calcium and Phosphorous Metabolism." Philip L. Harris, "Some New Tocopherol Effects in Nutrition."

6 August F. J. Stare, title to be announced later. Daniel Melnick, "Physiological Availability of the Vitamins."

7 August H. E. Longenecker, "Nutritional Value of the Fatty Acids." Elsie Dawson, "Taste Panels."

8 August H. L. Fevold, "Food and Feed Value of Yeast." Bacon F. Chow, "Biochemical Studies on Protein Hydrolysates."

9 August L. C. Norris, "The Role of Folic Acid and Related Substances in Nutrition."

CANCER

H. P. Rusch, Chairman; A. M. Brues, Vice-Chairman

12 August J. A. Miller and E. C. Miller, "The Metabolism and Carcinogenicity of p-Dimethylaminoazobenzene and Its Derivatives in the Rat." L. O. Jacobson, C. L. Spurr, G. F. Dick, and E. S. Guzman Barron, "Chemotherapeutic Studies in Lymphoma."

13 August Jack Schultz, "Nuclear Differentiation and the Origin of Tumors." C. Carruthers, "Some Chemical Changes Induced by Methylcholanthrene in the Transformation of Mouse Epidermis to Squamous Cell Carcinoma."

14 August W. C. Hueper, "The Significance of Industrial Tumors in Cancer Research." A. M. Brues, "Carcinogenic Effects of Some Radioactive Compounds That May Be a Problem in Certain Future Industries." P. S. Henshaw, "Carcinogenic Effect of Pile Radiations in Rats and Mice."

15 August S. Spiegelman, "The Synthesis and

Maintenance of Intracellular Enzymes." L. C. Strong, "The Induction of Germinal Mutations by a Carcinogenic Chemical." W. E. Heston, "Paths of Gene Action in Mammary Tumor Development in Mice."

16 August W. U. Gardner, "Steroid Hormones in the Induction of Cancer."

INSTRUMENTATION

R. D. Webb, Chairman; C. O. Fairchild, Vice-Chairman

19 August A. Keith Brewer, "The Mass Spectrometer: Its Principle of Operation and Its Application to Practical Analytical Problems." H. L. Andrews, R. C. Machler, and A. J. Williams, Jr., "Recording Methods in Spectrochemical Analysis."

20 August Gordon Brown, C. E. Mason, A. C. Hall, A. F. Sperry, and G. A. Philbrick, "Theories of Automatic Control."

21 August Gordon B. Sayre, "Applications of Modern Plastics in Instruments." V. Lawrence Parsegian, "A New Galvanometer." W. F. Swann, "New Photographic Materials and Methods."

22 August Charles F. Kettering, subject to be announced later. John J. Grebe, "Application of Control Principles to Human Endeavor."

23 August R. B. Sosman, "Pyrometric Control of the Open-hearth Furnace."

HISTORY

The Gibson Island Research Conferences were inaugurated on a substantial, continuous basis in 1938 by Dr. Neil E. Gordon. They have been sponsored by the American Association for the Advancement of Science since this time. Gifts by industrial companies whose laboratories have been represented at the Conferences have enabled the AAAS to purchase the Conference property. This property consists of a large residence and auxiliary building located on a wooded 3.6-acre lot on the highest hill on the Island. The property provides accommodations for about 56 persons in addition to the Conference room and library. All meals are taken at the Gibson Island Clubhouse.

LOCATION

Gibson Island is situated in Chesapeake Bay, about 23 miles south of Baltimore. It is approximately 1,000 acres in area, and is connected with the mainland by a causeway. Transportation to and from Baltimore is afforded by the Lakeshore Bus Company, which operates on a limited schedule. The Island offers opportunity for many sports: golf, tennis, both salt- and fresh-water bathing, fishing, and sailboating.

PURPOSE

The purpose of the Gibson Island Conferences is to stimulate research endeavor in universities, research foundations, and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and discussion of topics of current research interest.

The first meeting of the week is held Monday morning at 10 o'clock. Other morning sessions through Friday usually last from 9:30 to 12:00. The second session of the day is generally held in the evening from 7:30 to 10:00, Monday through Thursday. There are no Friday evening sessions, and Conference members are expected to check out Friday afternoon.

ATTENDANCE

Those interested in attending are instructed to send in their applications to the Director, on or before March 15. Each applicant must state the institution with which he is connected, and the type of work in which he is most interested.

The Director will submit the names of those requesting attendance to the chairman of the respective Conferences. The chairmen, in conjunction with a program committee, will go over the names and select the members in an effort to distribute the requests as fairly as possible among the various institutions represented. Names selected by the program committee will be returned by the chairmen to the Director, who will notify the selectees; at that time, each one who is to attend will be requested to register by mail. On receipt of the registration fee of $3.00, made payable to the American Association for the Advancement of Science, a registration card will be sent, giving admission to the Island and use of all guest privileges, including a room reservation. Rooms are $3.00 or $3.50 per day per person, and board is a la carte. On proof that the member is paying his own personal expenses, he may be granted a reduction of $1.00 per night on his room rent. This information should be given at the time the person makes a request for attendance. All registration fees will be returned and room reservations canceled, providing notice of inability to attend is received at least 15 days before the Conference.

Accommodations may be available for a limited number of women who wish to accompany their husbands. All such requests should be made at the time of the request for attendance, for these particular limited accommodations will be assigned in the order received.

All requests for attendance, or any additional information, should be addressed to Dr. Sumner B. Twiss, Chemistry Department, Wayne University, Detroit 1, Michigan.

Meeting Notes

General Sessions

At each annual meeting of the American Association for the Advancement of Science several "General Sessions" are held, the first of which is devoted largely to the address of the retiring president. At the St. Louis meeting on Wednesday evening, 27 March, Dr. Anton J. Carlson, emeritus professor of physiology at the University of Chicago and president of the Association in 1944, will deliver his retiring address on "Be There 'a Standard to Which the Wise and the Honest Can Repair'?"

Dr. Carlson's address, which will be delivered in the Opera House of the magnificent Kiel Auditorium, will be followed by a reception to members of the Association by leading citizens of St. Louis. It is expected that among the distinguished scientists present at this session will be Dr. Arthur H. Compton, formerly professor in the University of Chicago, now president of Washington University, and president of the Association in 1942; Dr. Charles F. Kettering, director of General Motors Research Laboratories and president of the Association in 1945; and Dr. James B. Conant, president of Harvard University and president of the Association during 1946. Rarely, if ever, in the 98 years since the Association was founded have four of its presidents and past presidents participated in one of its general sessions.

At the second general session, which will be held on Thursday evening, 28 March, in the Gold Room of the Jefferson Hotel, Dr. E. C. Stakman, of the University of Minnesota, will deliver the twenty-second lecture under the joint auspices of the Association and the Society of the Sigma Xi. On the following evening Dr. Irwin Edman, professor of philosophy in Columbia University, will deliver the eighth annual lecture under the joint auspices of the Association and the United Chapters of Phi Beta Kappa in the Gold Room of the Jefferson Hotel. The title of Dr. Edman's address will be "Science and the Dream of Happiness." On Friday evening, in the Kiel Auditorium, the National Geographical Society will present Mr. Luis Marden in a lecture on "Seeing Costa Rica," which will be illustrated by colored motion pictures.

Hotel Headquarters

Jefferson Hotel: General Headquarters.

Headquarters of the sections of the Association and of the societies meeting with the Association in St. Louis are as follows:

Claridge Hotel: Sections on Astronomy, Chemistry, Geology and Geography, Physics, and Mathematics; American Association of Geographers, American Association of Scientific Workers, American Institute of Mining and Metallurgical Engineers, American Meteorological Society, Geological Society of America, Institute of Mathematical Statistics, Mathematical Association of America.

Coronado Hotel: Section on Medical Sciences; Alpha Epsilon Delta.

DeSoto Hotel: Section on Agriculture; American Nature Study Society, American Society for Horticultural Science, Beta Beta Beta, Central Association of Science and Mathematics Teachers, Cooperative Committee on Science Teaching of the AAAS, National Association of Biology Teachers, National Council of Teachers of Mathematics, National Science Teachers Association, Union of American Biological Societies.

Jefferson Hotel: Section on Zoological Sciences; American Association of Economic Entomologists, American Microscopical Society, American Society of Naturalists, American Society of Parasitologists, American Society of Zoologists, Conference on Methodology of Science, Conservation Council, Ecological Society of America, Entomological Society of America, Gamma Alpha Graduate Scientific Fraternity, Limnological Society of America, National Association of Scientific Writers, Phi Beta Kappa, Sigma Xi, Society for the Study of Speciation.

Lennox Hotel: Genetics Society of America, Phi Sigma Society, Potato Association of America, Sullivant Moss Society.

Mark Twain Hotel: Sections on Education, Historical and Philological Sciences, Psychology, and Social and Economic Sciences; American Statistical Association, Midwestern Psychological Association, Pi Gamma Mu, Society for Research in Child Development.

Statler Hotel: Section on Botanical Sciences; American Fern Society, American Phytopathological Society, American Society of Plant Physiologists, American Society of Plant Taxonomists, Botanical Society of America, Mycological Society of America, Sigma Delta Epsilon.

Registration

All members of the AAAS are expected and urged to register. The registration fee is $1.00. The names and local addresses of persons registering will be listed in the Visible Directory located at the registration center. In addition to the *General program* listing papers and activities of all sections and of all societies meeting with the Association, registrants will receive a Convention Badge, since admittance to certain sessions and functions may be contingent upon display of this identification.

The main registration desks are to be located at the center of the exposition hall of the Municipal Auditorium. Street-level entrances on 14th and 15th Streets provide ready access to the main corridors between the exhibit booths leading to the registration center, which will be open at 8:00 A.M. each day. Supplemental registration desks will be open from 8:00 to 11:00 A.M. on Wednesday in the Coronado and Jefferson Hotels, on Thursday morning in the Statler Hotel, and on Thursday and Friday mornings in the DeSoto Hotel.

Persons desiring extra copies of the *General program* may secure them during the meeting for $1.00 each, or at a reduced rate by writing to the Permanent Secretary at the close of the meeting, if extra copies are then available.

Meetings of Sections and Societies

(A) *Mathematics.* The Section on Mathematics has planned three sessions, starting Friday, 29 March, at 2:30 P.M. in Room 4D of the Auditorium. The feature of the opening session will be the address of the retiring chairman, J. L. Walsh, of Harvard University, on "Taylor's Series and Approximation to Analytic Functions." Teaching problems will be emphasized in a joint session with the Missouri Section of the Mathematical Association of America on Saturday morning, and, following a luncheon for mathematicians and guests on the 15th floor of the DeSoto Hotel, an afternoon session with the Institute of Mathematical Statistics will consider applications of statistical techniques to engineering, business, and population.

(B) *Physics.* The Section on Physics has scheduled a single session, which will be held in Room 4C of the Auditorium on Friday, 29 March. The program will be of general interest to scientists attending the St. Louis meetings because it includes a talk by Rear Admiral H. G. Bowen on "Research Projects of the Office of Research and Inventions," as well as papers by F. O. Schmitt and M. D. Kamen on specific applications of physics to biological research. Another feature of the program is the retiring vice-presidential address on "Whither Physics?" by R. C. Gibbs, of Cornell University.

The American Meteorological Society has also planned two sessions and a luncheon for Friday, 29 March. Featured in the morning session are papers dealing with the relationship between storms and seismic records. Some applications of radar to meteorology will be considered in the afternoon meeting. Both sessions will be held in Committee Room A in the Auditorium.

(C) *Chemistry.* The Section on Chemistry has arranged a symposium on Chemotherapy which will extend through four sessions, starting Thursday morning and continuing until Friday afternoon. Arthur J. Hill will serve as chairman at the Thursday sessions, when R. B. Woodward, Selman A. Waksman, Walter Seegers, and K. P. Link will speak. On Friday contributors to the symposium include E. A. Evans, W. Price, M. Slein, S. P. Colwick, C. F. Cori, O. H. Gaebler, and R. J. Williams. For these sessions Henry Eyring will occupy the chair. A business meeting and dinner, scheduled for Thursday evening, with E. A. Doisy as honorary chairman, will be followed by the address of the retiring vice-president and chairman of the Section, Arthur J. Hill. Reservations must be made through Dr. N. E. Gordon, Wayne University, Detroit 1, Michigan, by 13 March. The business meeting and dinner will be held at the Hotel Jefferson; the regular sessions will take place in Assembly Room 4, Kiel Auditorium.

(D) *Astronomy.* The Section on Astronomy has planned sessions for the forenoon and afternoon of Friday, 29 March, and for the forenoon of Saturday, 30 March, with a Section luncheon at 1:00 P.M. Saturday. The headquarters hotel for the Section is the Claridge, and the meetings will be held in one of the session rooms of the Kiel Auditorium starting at 9:30 Friday morning. Two retiring vice-presidential addresses are scheduled for Friday afternoon. The first is by Robert R. McMath, of the McMath-Hulbert Observatory of the University of Michigan, on three-dimensional work on solar prominences. The second is by Seth B. Nicholson, of the Mt. Wilson Observatory, on "The Solar Cycle." J. J. Nassau, Section chairman, will deliver a paper on "Problems Relating to Objective Prism Spectra." W. W. Salisbury, director of research of the Collins Radio Corporation, will deliver a paper on "Possibilities in the Astronomical Use of Radar." Several other papers have been promised on subjects varying from photometric work and celestial navigation to comet orbits and the secular perturbations of Mercury.

(E) *Geology and Geography.* Section E will meet jointly with the Geological Society of America, Association of American Geographers, and Industrial Minerals Division of American Institute of Mining and Metallurgical Engineers for seven sessions on Wednesday, Thursday, and Friday, 27–29 March, in Committee Rooms B, B-1, B-2, and A of the Kiel Auditorium. Carl Tolman is chairman of the local committee.

On Wednesday, 27 March, a symposium of ten papers on Pennsylvanian problems, organized by H. R. Wanless, will occupy two sessions: Part I, Stratigraphic, meeting in Committee Room B at 9:00 A.M.; and Part II, *Paleontologic, meeting* in Committee Room A at 2:00 P.M. A session with seven papers on Industrial Minerals, organized by R. M. Foose, of the Industrial Minerals Division, A.I.M.E., will convene at 9:00 A.M. in Committee Room B, on Thursday, 28 March. The address of the retiring vice-president and chairman, Howard A. Meyerhoff, on "Geomorphology, the Inexact Science," will be delivered at 2:00 P.M. Thursday, 28 March, in Committee Room B. It will be followed by six papers on geomorphology, climatology, and geography, and will include a series of papers on geomorphic evolution of the Appalachian region. A symposium of eight papers on Pleistocene geology of the North Central states, convening at 9:00 A.M. Friday, 29 March, in Committee Room B-1, has been organized by Leland Horberg. Concurrently, a session devoted to General Geology will meet in Committee Room B-2. A session on Missouri geology, meeting in Committee Room B, has been organized by E. L. Clark for Friday at 2:00 P.M.

Section E meets with Section K for a joint session Wednesday afternoon (see program of Section K). On Thursday morning Section E also meets jointly with Sections O and K (see Section O program).

For Saturday, 30 March, informal field trips may be arranged through the local committee for those interested. The suggestions which have been made include inspection of the Paleozoic stratigraphic section near St. Louis, local glacial features, Saint Louis University Seismograph Station and Geophysical Institute, and features of interest on the Washington University campus.

(F) *Zoology.* The interests and activities of the Section on Zoology are closely identified with those of the American Society of Zoologists. The latter organization will hold its annual meeting at the Hotel Jefferson and at Washington University on 28, 29, and 30 March. In addition to a promising program of technical sessions, there will be several feature events. One is a symposium on "Dynamics of Production in Aquatic Populations," organized by A. S. Pearse and sponsored jointly by the Ecological Society of America and the Limnological Society of America. The session, including papers by Thomas Park, G. L. Clarke, R. W. Pennak, W. T. Edmondson, and W. E. Ricker, is scheduled for 2:00 P.M. Thursday in the Gold Room of the Hotel Jefferson. At the same time, in the Ivory Room, E. B. Babcock will address a joint session of the Society and Section G on "Crepis and Evolution." In conjunction with the Botanical Society of America, the Genetics Society of America, and the American Society of Naturalists, a symposium on "Recent Advances in the Dynamics of Behavior," organized by K. S. Lashley, will be held in the Ivory Room at 2:00 P.M. Saturday.

The American Society of Zoologists will join the American Society of Naturalists and other biological groups in sponsoring the Biologists' Smoker to be held on Thursday, 28 March, at 9:00 P.M. in the Kiel Auditorium. Admission will be by AAAS registration badge.

The annual dinner of the American Society of Zoologists, to which all zoologists and friends are invited, will be held at 6:30 Friday evening, 29 March, in the Crystal Room of the Hotel Jefferson. Dr. Carl G. Hartman, vice-president and chairman of Section F, will deliver the annual address on "The Little Researcher."

The North Central States Entomologists Branch of the American Association of Economic Entomologists will meet at the Jefferson, starting at 1:30 P.M., 27 March. Thursday morning, in a joint meeting with the Entomological Society of America, Clyde Kearns will tell of the insect control work of the Office of Scientific Research and Development, and a discussion of the place of entomology in the National Science Foundation will follow. This meeting, as well as the general session scheduled for Friday morning, is followed by an afternoon of sectional meetings and conferences.

The Entomological Society of America is planning three days of meetings, starting at 10:00 A.M. Wednesday, 27 March. Headquarters and meetings will be in the Hotel Jefferson. In the Society's several sessions 24 technical papers will be presented, and on Thursday afternoon, after a short technical program, the Society will hold its annual business meeting. A meeting of the Executive Committee will be held Wednesday at 8:00 P.M. in Private Dining Room No. 5. Special features include the joint session with the North Central States Entomological Branch of the American Association of Economic Entomologists at 9:30 A.M. Thursday in the Crystal Room; the entomologists' banquet at 7:00 P.M. Thursday in the same room, to be followed by the address of the president of the Entomological Society of America, James A. G. Rehn; and a joint session with the Ecological Society of America at 9:30 A.M. Friday.

The American Society of Parasitologists will hold its twentieth annual meeting at St. Louis from 28 to 30 March, inclusive. Headquarters for the Society will be in the Hotel Jefferson, and except for the demonstrations, the technical sessions, involving the presentation of 69 papers, will take place in Private Dining Room No. 9 in this hotel. Special features include the presidential address of Asa C. Chandler on "The Making of a Parasitologist," to be given at 11:00 A.M., 29 March. The address will be followed at 12:30 P.M. by the Parasitologists' luncheon, and a business meeting at 1:30 P.M. will precede the afternoon demonstration program.

(G) *Botany.* The several botanical and biological societies have arranged a crowded schedule of activities in which the Section on Botany, as such, will play a small, though important part. The Section will sponsor a joint session on Thursday at 2:00 P.M. in the Ball Room of the Hotel DeSoto, and other joint meetings involving two or more societies are features of the botanical sessions.

The Botanical Society of America will hold its fortieth annual meeting from 28 to 30 March, inclusive. The Statler Hotel will be official headquarters. The sessions of the several sections of the Society will begin Thursday morning and will run through Saturday afternoon.

The all-botanists' dinner is scheduled to take place on Thursday at 6:00 P.M. in the Statler. In addition to the joint meeting with Section G on Thursday afternoon, there will be other joint meetings with the American Society of Plant Physiologists, the Mycological Society of America, the American Society of Plant Taxonomists, the Ecological Society of America, and the American Society for Horticultural Science. Special symposia on photosynthesis, radioactive substances, mineral nutrition, paleobotany, and systematic botany are being arranged for the joint sessions, while the programs of the other sections will consist in large part of contributed papers of a technical character. A new section of the Society, the Microbiological Section, has been authorized by the Council and will hold its first meeting at St. Louis.

The American Phytopathological Society will meet on 27 to 30 March, inclusive, with headquarters and meetings at the Hotel Jefferson. The annual dinner of the Society is scheduled for Thursday evening. In addition to the joint session with Section G on Thursday afternoon, there will be joint meetings with the Potato Association of America on Friday morning and with the Mycological Society of America on Saturday morning. Ninety technical papers will be presented in the meetings of the Section on Fungicides, Viruses, Factors Affecting Disease Development, Forest Pathology, Genetics, Physiology of Pathogenic Fungi, Cereal Diseases, and Vegetable Diseases.

The interests of the American Society of Plant Physiologists and the Physiology Section of the Botanical Society of America are so closely identified that joint sessions of the two groups have been scheduled for Thursday, Friday, and Saturday in parlors 102, 104, and 106 in the Statler. In addition to the joint session with Section G on Thursday afternoon, there will also be a joint session with the Section on Agriculture and the American Society for Horticultural Science on Friday, to consider "Mineral Nutrition of Plants and Animals." A dinner has been arranged for the physiologists on Friday evening at the Statler.

The Mycological Society of America will begin its sessions on Thursday at 9:00 A.M. in Room 4C of the Auditorium. A program of technical papers will follow the business meeting, and other technical sessions are scheduled in the same room for Friday morning and afternoon. On Thursday afternoon, in the joint session with Section G and the other botanical organizations, the address of the retiring president of the Society, Frank Kern, of Pennsylvania State College, will be given on the subject, "Some Bases for Mycological Progress." On Saturday morning there will be a joint session with the American Phytopathological Society and the Botanical Society of America. Thursday evening, following the dinners of the phytopathologists and botanists, there will be a joint meeting in Room 3A of the Auditorium to consider the formation of a general organization of biologists.

On Friday at 6:00 P.M., a dinner will be given by Anheuser-Busch, Inc., at the company's brewery. The dinner will be followed by a program of papers dealing with the scientific and practical aspects of yeast, to be led by Carl C. Lindegren at Washington University.

The Sullivant Moss Society will open its sessions with a breakfast on Friday morning, to be followed by a program of general papers and in the afternoon, by a symposium on the phytogeography of mosses, sphagna, hepatics, and lichens. On Saturday a field trip has been arranged for the members of the Society, who will journey to St. Genevieve County, about 80 miles south of St. Louis.

The American Society of Plant Taxonomists has arranged two joint sessions with the Systematic Section of the Botanical Society of America. These meetings will be held on Thursday and Friday mornings, and on Friday evening at 6:00 there will be a dinner of the Society, followed by an address by Francis W. Pennell.

(F-G) *Zoological and Botanical Sciences.* The program of the American Society of Naturalists starts on Thursday at 4:00 P.M. with a meeting of the Executive Committee at the Hotel DeSoto. The Society will meet with the Union of American Biological Societies at 8:00 P.M. Thursday evening in the Auditorium to consider plans for a Biological Institute, and this meeting will be followed by the Biologists' Smoker in the session rooms on either side of the Grand Lounge. A business meeting will occupy Saturday morning, and at 2:00 P.M., in the Ivory Room of the Hotel Jefferson, a joint session with the American Society of Zoologists, the Botanical Society of America, and the Genetics Society of America, on "Recent Advances in the Dynamics of Behavior," will be concluded by the presidential address of Edmund W. Sinnott on the subject, "Substance or System, the Riddle of Morphogenesis."

The Ecological Society of America will hold its thirtieth annual meeting from 28 to 30 March. In addition to technical sessions for the discussion of research on plant and animal ecology, the Society will join the American Society of Zoologists and the Limnological Society of America in a symposium on aquatic populations, scheduled for 2:00 P.M. Thursday in the Gold Room of the Hotel Jefferson. There will be a joint session with the Entomological Society of America at 9:30 A.M. Friday in the Crystal Room of the Jefferson, joint sessions with the Botanical Society of America at 9:30 A.M. and 2:00 P.M. on Saturday, a conference on the teaching of ecology at 9:30 A.M. on Friday, and a special program on applied ecology at 2:00 P.M. on Friday. The ecologists' dinner is scheduled for 7:00 P.M. Friday, and following the dinner, Robert F. Griggs, past president of the Society, will give an illustrated address on "Timberlines of North America and Their Significance." Saturday afternoon an excursion to the St. Louis Zoo has been planned.

The program of the Genetics Society of America will start with a demonstration program on Thursday morning at Washington University. In addition to technical sessions scheduled for Thursday and Friday afternoons at the Hotel Lennox, there will be a joint session with the Biometrics Section of the American Statistical Association on Friday morning, to consider "The Statistical Analysis of Hybrid Vigor." Invitational papers by Drs. Mirsky, Pollister, Ris, Stern, Lindegren, Muller, Russell, and Douglass will be presented on Saturday morning, and on Saturday afternoon the Society will join the American Society of Naturalists in a joint session on "The Neurodynamics of Behavior." The annual luncheon and business meeting of the Society will be held Friday noon.

For the American Microscopical Society the program at St. Louis will constitute the sixty-second annual meeting. The Society program includes an Executive Committee luncheon on 28 March at 12:30 and the annual business meeting at 4:00 P.M. Friday. Headquarters and meetings will be in the Hotel Jefferson.

The Limnological Society of America will hold its annual meeting on Thursday and Friday, 28 and 29 March, with headquarters and session meetings in the Hotel Jefferson. On Thursday afternoon the Society will join with the American Society of Zoologists and Ecological Society of America in the presentation of a symposium entitled "Dynamics of Production in Aquatic Populations." The morning and afternoon sessions on Friday will be devoted to technical papers on limnology and closely allied subjects. The annual business meeting will conclude the Friday afternoon sessions.

The National Association of Biology Teachers will meet on 29 and 30 March. Headquarters will be established in the Hotel DeSoto, and on Friday business sessions will be held in Parlor D in this hotel. Following an address of welcome by Prevo L. Whitaker, president of the Association, at 10:00 A.M. in the Ball Room of the DeSoto, the regular Saturday sessions will be devoted to aspects of conservation. An address by Otis W. Caldwell on "Of What Does Good Biology Teaching Consist?" will conclude dinner at 6:30.

The Union of American Biological Societies has scheduled a joint meeting of the biological organizations participating in the St. Louis convention to consider plans for a Biological Institute. This meeting will be held at 8:00 P.M. Thursday in the Auditorium, immediately preceding the Biologists' Smoker.

On 29 March the American Nature Study Society will hold its forty-first annual meeting. The Society program, which is scheduled to start at 2:00 P.M. in the Hotel DeSoto, features a series of papers on "Conservation Education," to be followed by a general discussion under the chairmanship of E. L. Palmer, of Cornell University. The annual business meeting of the Society will be held at 8:00 P.M. in the Jefferson National Expansion Museum, with President Charles E. Mohr presiding. This meeting will be concluded with a showing of nature pictures.

Beta Beta Beta will meet in Parlor D of the Lennox Hotel Thursday afternoon, 28 March. There will be a luncheon at 12:30, followed by a memorial program for the late President C. E. McClung. The biennial business meeting and election of officers will conclude the session.

Phi Sigma Society will limit its activities to the meeting of the National Council. Starting at 8:00 P.M. Wednesday, the Council meetings will continue through Saturday morning in Parlor A at the Hotel DeSoto.

(I) *Psychology.* The Section on Psychology and the Midwestern Psychological Association will meet jointly on 28, 29, and 30 March. The meetings will be held in Rooms 3C and 3D of the Auditorium and will include 43 technical papers. On Thursday afternoon, in a joint session with Section Q (Education), Sidney L. Pressey, of Ohio State University, will deliver his address as retiring president of the Midwestern Psychological Association on the subject "Acceleration: Disgrace or Challenge." Florence Goodenough, of the University of Minnesota, will present her address as retiring vice-president of the Section on Psychology on the subject, "Semantic Choice and Personality Structure." The address of H. H. Remmers, of Purdue University, retiring vice-president of the Section on Education, on the subject, "You *Can* Change Human Nature," concludes the session. Of the technical sessions the two scheduled for Thursday morning will be concerned, respectively, with "Learning" and "Clinical and Abnormal Psychology." On Friday the morning program will be concerned chiefly with "Animal Psychology and Perception"; the afternoon program, with "Social Psychology." The Section and its affiliate will conclude their meetings with two sessions Saturday morning, dealing, respectively, with "Physiological Psychology" and "Psychological Tests."

Running concurrently with the Friday program of Section I and the Midwestern Psychological Association will be morning and afternoon sessions of the Society for Research in Child Development. Papers by L. W. Sontag, H. E. Jones, H. H. Anderson, R. J. Havighurst, Robert R. Sears, John E. Anderson, and others are scheduled for presentation in these sessions.

(K) *Social and Economic Sciences.* The Impact of Technology on Society will be the theme of six sessions sponsored by Section K. The meetings will begin on 27 March at 2:30 P.M. with a session in cooperation with Section E on "The Impact of Technology in Relation to Planning." Thursday morning a program on "Technology and Economic Organization" has been arranged in conjunction with the National Planning Association. The afternoon session, which was arranged by the Academy of World Economics, will consider "Technology and International Relations." Friday morning, in collaboration with the Department of Rural Sociology at the University of Missouri, Section K will give special attention to regional study, with emphasis upon the Missouri Valley problem. The Pi Gamma Mu luncheon will follow this session, and it will feature the address of S. Howard Patterson, who retires as chairman of Section K and vice-president of the Association, as well as an address on "Science and Religion" by Edwin McNeill Poteat, president of the Rochester-Colgate Divinity School. The series will end Saturday morning with a session on "Human Conservation." Among the speakers in the several sessions are S. Colum Gilfillan, of the University of Chicago; Paul Greer, farm editor of the *St. Louis Post-Dispatch*; Harold Urey, of the University of Chicago; and F. B. Heinkel, president of the Missouri Farmers Association. The Academy of World Economics and the Pi Gamma Mu Society have cooperated in the preparation of the program, and the American Library Association has arranged a book exhibit on Science and Society.

The American Statistical Association, an affiliate of Section K, has arranged three symposia. The first, under the chairmanship of Fred J. Halton, Jr., of Deere and Company, is scheduled for 2:30 P.M., 27 March, and will deal with "Quality Control in American Industry." At 10:00 A.M. on Thursday, "Social Sampling and the Measurement of Opinion" will be the subject, with W. F. Ogburn, of the University of Chicago, in the chair. Participants in this program will include Samuel A. Stouffer, of the Social Science Research Council; George A. Gallup, of the American Institute of Public Opinion; and Philip M. Hauser, of the Department of Commerce. In the afternoon consideration will be given to "Personnel Selection by Psychological Tests," under the chairmanship of Capt. John G. Jenkins, of the Bureau of Medicine and Surgery, Navy Department. In addition to the three general sessions, the Biometrics Section of the Association will hold technical sessions dealing with the applications of statistical methods in biological work.

(M) *Engineering.* The Section on Engineering has planned no separate sessions for the St. Louis meeting, but the Industrial Minerals Division of the American Institute of Mining and Metallurgical Engineers has arranged a joint session with Section E on Thursday, 28 March, at 9:00 A.M. in Committee Room B of the Kiel Auditorium. Industrial minerals and rock products in the Central states will receive special consideration.

(N) *Medical Sciences.* The Section on Medical Sciences, in cooperation with the Council on Industrial Health of the American Medical Association, has organized a symposium on "Medical Science and Industry." One of the outstanding developments of the war has been an appreciation of the expanding concept of the field of industrial health, encompassing both the physical well-being and the mental outlook of the worker. The use of raw materials and intermediates which have heretofore been laboratory curiosities or little more than formulas on paper has exposed war workers to physical and chemical agents of unknown action. Despite precautions, scientists could not always predict the lethal action of their creations; and prompt rehabilitation of injured workers was essential to vital production. Mental adjustments to the speed-up of the emergency worked untold psychic upsets and created new mental problems. In four sessions, scheduled for the mornings and afternoons of 27 and 28 March, the Section will review these war problems and the contributions of medical science to their solution, in the belief that such a view will aid in the development of a positive health program in industry during the postwar period. A total of 19 papers will be presented by outstanding investigators on the general topics of atomic energy, trauma, occupational restoration and positive health in employment procedures, and industrial medicine as a special discipline and industrial toxicology. The address of the retiring vice-president, Warfield T. Longcope, entitled "The Importance of Researches Upon War Gases to Clinical Medicine," will bring the symposium to a close. All sessions will be held in Room 1807 of the auditorium of the Washington University School of Medicine, 4580 Scott Avenue.

Alpha Epsilon Delta, national honorary premedical fraternity, in conjunction with Section N (medical sciences), is arranging a special program on premedical advisory problems for the AAAS meeting in St. Louis. The symposium will be held in the Coronado Hotel at 1:30 P.M., Friday, 29 March.

Dr. Carlyle F. Jacobsen, Assistant Dean, Washington University School of Medicine, St. Louis, will present a thorough discussion of the use and measurement value of the various *objective* methods of investigating the educational background of the student. This will be followed by a discussion by Dr. George T. Harding, School of Medicine, The Ohio State University, Columbus, of the personality traits to be found and recognized in recommending students for the study of medicine. The second half of the program will deal with the length and content of the premedical curriculum. Dean Stanley Dorst, School of Medicine, University of Cincinnati, will present the point of view of the medical school and Dr. William H. Cole, Rutgers University, New Brunswick, New Jersey, that of the liberal arts college.

The discussion will be directed to answering questions directly related to the problems concerned with the preparation of students for the study of medicine and the selection of candidates for recommendation and admission. All interested medical and premedical educators and students are invited to attend and participate in the symposium.

(O) *Agriculture.* The Section on Agriculture has planned a symposium jointly with the Section on Geology and Geography and the Section on Social and Economic Sciences for Thursday at 9:00 A.M. in Room 3A of the Auditorium. The symposium will give consideration to modern concepts of soils, factors causing divergence in soil properties during soil formation, the relation of soils to plant growth, and the relation of soils to the distribution of human populations. At 2:00 P.M. Friday, on the 15th floor of the DeSoto Hotel, the Section will join with the American Society for Horticultural Science, the American Society of Plant Physiologists, and the Physiological Section of the Botanical Society of America for a program of papers dealing with "Soils in Relation to the Nutrition of Plants, Animals, and Man." Attention will be focused on cellular and tissue metabolism, nutritional deficiencies of farm animals as related to soil and crop composition, nutritional diseases of man in relation to geographic areas, and the importance of soil fertility in human welfare. The last subject will be the theme of the address of the retiring vice-president and chairman of Section O, William A. Albrecht, whose paper will conclude the program.

The Potato Association of America will meet jointly with the American Society for Horticultural Science on Thursday and with the American Phytopathological Society on Friday.

The American Society for Horticultural Science will begin its activities on Thursday morning with two sessions—one of them the joint meeting with the Potato Association of America, and the other, a general session on pomology. Thursday afternoon a general session on chemical weed control will be followed by a joint session with the Biometrical Section of the American Statistical Association. Thursday evening has been set aside for round-table discussions on Plant Genetic Stocks. Simultaneous sessions on pomology, vegetables, and floriculture and ornamental horticulture will occupy Friday morning, and Friday afternoon has been set aside for the joint symposium on "Mineral Nutrition of Plants and Animals." The annual banquet of the Society is scheduled for 6:30 P.M. Friday, when W. B. Mack, of Pennsylvania State College, will deliver his retiring presidential address. At 9:30 there will be a round-table panel discussion on Teaching Methods. Saturday morning the schedule calls for simultaneous sessions on vegetables, pomology (propagation), and fruit storage and processing. The meetings of the Society will be concluded Saturday afternoon with a general business session, followed by two technical sessions on nuts and small fruits.

(Q) *Education.* Five sessions of Section Q are planned, beginning at 9:30 Wednesday morning, 27

March, and closing at noon on Friday. Included is a joint meeting on Thursday afternoon with Section I and the Midwestern Psychological Association, at which time Florence L. Goodenough, retiring chairman of Section I, H. H. Remmers, retiring chairman of Section Q, and Sidney L. Pressey, president of the Midwestern Association, will be heard. The other sessions will be concerned with various aspects of educational and personnel programs in the Armed Services by those who were prominently identified with them. In this connection, Ralph Bedell (Nebraska), Henry Beaumont (Kentucky), Guy Bond (Minnesota), Alonzo Grace (American Council on Education), Shailer Peterson (Chicago), Raleigh Schloring (Michigan), and William Spaulding (Houghton Mifflin Company) may be mentioned. Other topics, such as the educational reorientation of veterans, guidance and adjustment in the public schools, postwar education, self-teaching materials, discipline, teaching efficiency, the curriculum, and the like, will round out the offerings of this Section. Owing to the importance of the subjects dealt with, a deliberate attempt has been made to prevent the overcrowding of any session with miscellaneous papers.

(X) *Science in General.* The graduate women's scientific fraternity, Sigma Delta Epsilon, will hold a National Council meeting starting at 2:00 P.M., 27 March, in Parlor 106 of the Hotel Statler. The Council will remain in session through Friday morning. On Thursday, Virginia Bartow, of the University of Illinois, will speak on the subject, "American Women in Chemistry," at the luncheon for All Women in Science, and the Friday meeting of the Council will be preceded by a breakfast and the annual business meeting of the fraternity.

The National Science Teachers Association has arranged a series of meetings in partial collaboration with the Cooperative Committee of the AAAS, the National Council of Teachers of Mathematics, the Central Association of Science and Mathematics Teachers, the American Nature Study Society, and the National Association of Biology Teachers. Following committee and business meetings on Thursday afternoon and evening, a general session of the Association will be held Friday morning at the Christ Church Cathedral (1210 Locust Street). The other sessions will be held in the Hotel DeSoto. On Friday afternoon recent studies and developments affecting science teaching in colleges and secondary schools will be considered. At the Leaders' dinner which will follow the afternoon session, there will be a discussion of "Unity and Action in Science Education." Saturday will be devoted to a consideration of "Science in the School Curriculum." Starting with a joint session at which A. J. Carlson will be the main speaker, the meeting will be continued in group sessions, one for each of the cooperating societies. The afternoon session will be conducted in the same manner, with Ira Gabrielson as the principal speaker at the joint session. The Association will join with the National Association of Biology Teachers for dinner Saturday evening and for the address by Otis W. Caldwell. The Board of Directors of the National Science Teachers Association is scheduled to meet on Sunday after the regular sessions have been concluded.

Additional Notes

Other Societies and Sections have indicated their intention to hold sessions at St. Louis, but they have not submitted statements of plans as this issue of *Science* goes to press.

Last-minute corrections and additions to the program will be announced in *Science.* In order to expedite this late news the secretaries or others responsible for the arrangements should forward the original of an announcement to Dr. Howard A. Meyerhoff, Smithsonian Institution Building, Washington 25, D. C., and a carbon copy to the Editor of Science, Massachusetts and Nebraska Avenues, Washington 16, D. C.

The Meeting 27–30 March 1946 is the fifth St. Louis meeting. The Association first met in St. Louis in 1878, when 134 members were registered and 103 papers read. The total membership of the Association was 558 at that time.

Scientists of the St. Louis area were hosts to AAAS in 1903 and 1919 for the second and third times.

Saint Louis University began its work in 1818, three years before Missouri was admitted to the Union.

Washington University was first chartered as Eliot Seminary in 1853.

The Academy of Science in St. Louis was founded in 1856.

The fourth St. Louis meeting was held during the Christmas holidays in 1935. Approximately 2,300 people were registered and 1,200 papers read. There were 47 associated societies in session at the same time, and the total membership of the Association had grown to 18,102.

The fourth St. Louis meeting, 1935, was held in part in then unfinished St. Louis Municipal Auditorium. Reports from that time indicate that many last-minute changes in the program were necessitated by the unfinished condition of the building. Washington University, on learning of the situation, placed its entire plant and facilities at the disposal of Henry

B. Ward, who was at that time permanent secretary of the Association.

President Karl T. Compton of the Massachusetts Institute of Technology, presided at the general sessions at the fourth St. Louis meeting in 1935.

Since the Association last met in St. Louis, the name of the St. Louis municipal auditorium has been changed to the Kiel Memorial in honor of the long-time mayor of St. Louis.

The Society of Sigma Xi held its fourteenth annual meeting as an affiliate of AAAS under the leadership of Professor G. H. Parker, president of the society, at the 97th meeting of the Association in 1935.

The first annual lecture of Phi Beta Kappa as an affiliate of AAAS, was delivered in 1935 by William Allen Neilson, president of Smith College.

At the St. Louis meeting of the American Association of University Professors, 1935, Dr. A. J. Carlson, chairman of the Department of Physiology, University of Chicago was elected president for 1936. Dr. Karl T. Compton made the address at the annual luncheon.

Dr. Harold G. Moulton, president and director of the Brookings Institution, spoke at the Thursday evening General Session on "The Scientific Method in the Investigation of Economic Problems."

Edwin Grant Conklin was elected president of the Association for 1936 at the St. Louis meeting.

There were 25 requests for grants-in-aid in 1935 totalling $9,000, but the Committee regretfully announced through its Chairman, Walter R. Miles, that only $3,000 was available for this purpose.

The greenhouses of the city botanical garden show many improvements over their condition 10 years ago when the Association last met in St. Louis. Special floral displays have been arranged for the period 27–30 March.

The entire orchid collection, about 20,000 plants, of the Missouri Botanical Garden is now housed in the arboretum at Gray Summit on the northern fringe of the Ozarks overlooking the Meramec River.

The Washington University cyclotron is housed in a special building near Crow Hall. It is understood that visitors will be welcome during the period of the fifth St. Louis meeting.

Saint Louis University is especially noted for its work in medicine and seismology. It was the first institution in the world to establish a department of geophysics, and is still the only university in the United States to have a separately organized department of this kind.

The reptile and bird houses of the St. Louis zoological gardens are considered the best in the world.

A modern greenhouse known as the "Jewel Box," is located at the municipal Forest Park, which also contains the Art Museum and the Jefferson Memorial within its 1400-acre tract.

The casual visitor as well as the engineer will be interested in the visible evidence of the effectiveness of St. Louis' smoke abatement ordinance.

As Science goes to press news reaches us that Carl Snyder, vice-president of Section K, died in Santa Barbara, California, 15 February.

Science Legislation

The National Science Foundation: S. 1850, Final Senate Bill

Howard A. Meyerhoff
Executive Secretary, AAAS, Washington, D. C.

SCIENCE HAS ENDEAVORED to keep its readers informed on the progress of science legislation. Although it is possible to piece together a coherent story from the reports, texts of bills, and news items which have been published, the task is difficult, and there are not many who have the time to undertake it. In the belief that the legislative situation will be a topic of widespread discussion at St. Louis, a factual summary and analysis may prove useful as a background for such discussions as occur.

Although science has played an important role in many government departments, it was not until 1945 that it featured in Congress. About three years ago Senator Kilgore, of West Virginia, drafted a bill for which scientists and the Congress were not prepared. Its premature appearance and its defects, in combination, were more than this bill could survive. One of the unfortunate aftermaths of this first science bill was a suspicion of all proposed legislation, coupled with a prejudice against anything which Senator Kilgore might introduce in the scientific field. These suspicions engendered by the first science bill have seriously retarded progress in the consideration of the several bills introduced into Congress during 1945.

Chronologically the first of these to appear was a bill (S. 825) introduced by Senator Byrd on 4 April 1945. Briefly, it proposed the establishment of a Research Board for National Security as an independent government agency. Its principal objective was the creation of an agency competent to formulate scientific research for the Departments of War and Navy. A somewhat similar bill was introduced into the House by Representative May on 11 June, but here it was proposed that the Research Board be set up by the National Academy of Sciences in cooperation with the War and Navy Departments. It was in July that the Senate really warmed up to the idea of introducing science legislation. On the 9th, Senator Fulbright proposed, in S. 1248, to set up within the Department of Commerce a Bureau of Scientific Research to encourage research and to develop inventions, products, and processes which might prove useful to business. The proposed Bureau would absorb the Office of Production Research and Development of the War Production Board and the National Inventors Council. On the 19th, Senator Magnuson introduced S. 1285, which translated into legislation the major recommendations of Vannevar Bush's Report to the President, *Science: the endless frontier.* Four days later Senator Kilgore introduced a more comprehensive bill, S. 1297, embracing many of the features of S. 1285, but including the social sciences and some patent proposals. S. 1297 differed from S. 1285 in one other important particular, namely, in proposing that a National Science Foundation be administered by a Director rather than by a Board of unpaid, part-time scientists.

The overlapping objectives of the four Senate bills made the need for further study and coordination evident, and during the months of August and September Senators Fulbright, Kilgore, and Magnuson agreed to hold joint hearings on their respective bills. Meanwhile, the President's message of 6 September, although designed to stress the need of science legislation and to harmonize the proposals obtained in the several bills, in effect magnified the differences among them and created a rift that made S. 1285 and S. 1297 rival bills. Each of them slowly acquired partisan support among scientists, and the October hearings widened, rather than healed, the rift.

Starting early in August the American Association for the Advancement of Science interested itself in the legislation and made an earnest effort to secure improvements which were deemed vital if either S. 1285 or S. 1297 were to be enacted into legislation. By means of a questionnaire sent to members of the Council and distributed ultimately to approximately 600 scientists in different parts of the country, the Association obtained a sufficiently reliable background of opinion to enable it to take an active part in the hearings and in senatorial staff conferences. Over 90 per cent of the returns indicated definitely that American scientists want a National Science Foundation, and the Association regarded this strong desire of its membership as a mandate to work for the best possible legislation.

Approximately 100 scientists and a few laymen participated in the October hearings. The selection of witnesses was, for the most part, made without reference to the views which they held and, indeed, an earnest effort was made to obtain every shade of opinion from university, industrial, and government scientists, as well as from agencies and businesses whose chief concern is the application of science. Of all the witnesses, only one went on record as being opposed to the establishment of a National Science Foundation. A clear majority favored the inclusion of the social sciences in the Foundation. A majority likewise favored the Board form of administration, as opposed to administration by a Director appointed by the President. Except among the industrial groups, the interest in patent problems and issues was comparatively low, but there was a clearly defined concern about the free dissemination of results of government-supported research.

For a time it was hoped that these consolidated hearings might result in a consolidated bill, but the combination of circumstances led in the opposite direction. The old prejudice against Senator Kilgore led to a misrepresentation of his position, particularly among those scientists who, for one reason or another, favored the Board form of administration, the exclusion of the social sciences, and the exclusion of patent provisions from the bill. During November this rather miscellaneous group formed the Committee Supporting the Bush Report, which came out definitely against S. 1297 and for S. 1285. The majority of scientists, on the other hand, found themselves unable to give unqualified support to either of the two bills and so worked consistently for still better legislation in the form of a new bill. Their efforts led to the introduction of S. 1720 on 21 December. This bill, introduced by Senator Kilgore, with Senators Johnson, Pepper, Fulbright, and Saltonstall as co-sponsors, embodied so many changes and improvements that it provided a new basis of discussion.

In January, through the intervention of Senator Thomas, of Utah, representatives of the Committee Supporting the Bush Report were brought together with Senators Kilgore and Saltonstall, and several modifications in the provisions of S. 1720 were proposed and carefully considered. On 9 February everyone concerned agreed upon a somewhat revised version of S. 1720, which was introduced into the Senate as S. 1850 on 21 February, and which will be known as the Kilgore-Magnuson Bill. In addition to Senators Kilgore and Magnuson, Johnson, Pepper, Fulbright, Saltonstall, Thomas, and Ferguson are sponsoring S. 1850.

The full text of the revised bill has already been printed (*Science*, 1946, **103**, 225–230; 240) and comments on it have been made (*Science*, 1946, **103**, 192). Only a brief analysis of its provisions will be attempted. It establishes a National Science Foundation with broad powers and objectives. The affairs of the Foundation will be directed by an Administrator who will be aided—and checked—by a National Science Board, composed of high-ranking scientists selected by the President. The Board shall have a voice in the selection of the Administrator, and it shall have direct access to the President and to the Congress, both in reporting on the achievements of the Foundation and in supporting or opposing specific acts of the Administrator. Within the Foundation there will be divisions of (1) mathematical and physical sciences, (2) biological sciences, (3) social sciences, (4) health and medical sciences, (5) national defense, (6) engineering and technology, (7) scientific personnel and education, (8) publications and information. Additional divisions, not to exceed three in number, may be created by the Administrator, by and with the advice of the Board. Inasmuch as the work of the natural science divisions will be guided by the carefully prepared reports of Vannevar Bush and his committees, the work of the division of social sciences is restricted until a comparable report is prepared, detailing the proposed research in this general field. Public ownership of patents and free dissemination of information arising from Foundation-supported research are provided for, but the Administrator is given latitude and discretion in regard to patents, specifically in contracts which involve substantial contributions to the development of particular inventions, discoveries, and developments on the part of the organizations to which such contracts are given.

Apart from the solution of the controversial issues, the new bill provides for a broad program of support for research and for scientific education and cooperation. Scrupulous care has been taken to leave research and researchers free and unrestricted, save as the Foundation may deny support when particular projects are unsound or unwarranted. International cooperation and interdepartmental coordination within the United States Government are other important adjuncts to the proposed science legislation.

Although the phraseology of S. 1850 as printed (*Science*, 1946, **103**, 225–230; 240) has proved acceptable to scientists and to the Senators involved,[1] it may yet undergo major or minor changes when the bill is presented to the full Senate Committee on Military Affairs, and again when it is reported out of Committee and onto the Senate floor. Once proposed legislation reaches the floor of the Senate, amendment is an uphill job, but it must be remembered that a rival bill was recently introduced by Senator Willis (S. 1777), and that there may be some pressure from this group to secure modifications in the bill which comes from the Committee on Military Affairs, with concurrent support from the Committee on Commerce. However, it has been admitted by several of the co-sponsors of S. 1777 that their support was given primarily because of the rift among the scientists. S. 1777 provided for further study of the situation and commanded their support for this reason. The reason no longer exists, and it is hoped that this group of Senators will support the legislation which the vast majority of scientists approve.

The fate of the new bill in the House of Representatives is unpredictable. The May Bill (H.R. 3440) has already been passed, but it provides solely for military research. The new Senate bill incorporates many of the provisions of the May Bill, applying them specifically to the Division of National Defense; and it may be hoped that the supporters of the May Bill will find the Kilgore-Magnuson document acceptable as a substitute and as an amplification of the Government's research program. The Luce Bill (H.R. 5332), which was introduced on 1 February 1946, does not appear to be rival legislation. It proposes the creation of a Department of Science and Research, with a Secretary of Science and Research in the Cabinet. The proposed divisions of the new department do not include all of the fields of science, and the proposed groupings are open to serious criticism. The Luce Bill offers nothing which scientists can support and creates the serious hurdle of obtaining recognition of a new Cabinet post. It is safe to conclude that none of the science legislation currently before the House will prove competitive; but, on the other hand, there is reason to believe that the Representatives are more interested in economy than they are in the support of science. There has been comparatively little opportunity for members of the House to familiarize themselves with the thinking that has gone into the Kilgore-Magnuson Bill, and it is clear that an important job of education lies ahead and that the scientists are best qualified to undertake it.

---

[1] There has been one change in the phraseology of S. 1850 as printed (*Science*, 1946, **103**, 225–230; 240). In Section 4 (b), second paragraph (p. 226), the second sentence in the final draft now reads as follows: "The Administrator shall pay the compensation of such executive secretary and may furnish the Board and the divisional scientific committees such additional personnel, and such facilities, services, and supplies as may be necessary for the proper performance of the functions of the Board and the divisional scientific committees."

At a time when our allies in the late war are giving generous support to science, and when American science has lost 100,000 or more recruits in scientific research through the operation of Selective Service, it is appropriate to endorse and actively to support legislation which is designed to supplement the contributions which our industries and our educational institutions are making to scientific research. A Senator or a Representative can take intelligent action only when he is informed of the action his constituents want him to take. A resolution gets some attention, a letter from an individual is more informative, a telegram is somewhat better than a letter, but a personal call on his Senator now or his Representative a little later is the best way that an individual scientist can take positive action to ensure the passage of the Kilgore-Magnuson Bill, S. 1850.

Science Exhibition

Kiel Memorial Hall, St. Louis

27-30 March 1946

Now that Association meetings are again being held, it is possible to resume the important and interesting Science Exhibition. The Exhibition, which has long been an integral part of the meetings, will be housed in the Auditorium, located on Market Street between 14th and 15th Streets. The building is conveniently located with respect to the meetings of the various sections, which will be held in nearby hotels.

The same high standards in effect during prewar years have been maintained for this year's Exhibition, and we wish to express our appreciation for the cooperation we have received from the exhibitors who have helped to make possible this feature, which all of the members find most useful.

. Some institutions and concerns who have recently decided to take part in the Exhibition were not able to send descriptive material for publication at the early date that this issue of *Science* went to press. It is our hope, however, that it will be possible to have available complete information which may be obtained at the Registration Desk to be located in the center of the Exhibition area.

At our request, the exhibitors have furnished us with the following descriptions of their exhibits:

A. S. Aloe Company

St. Louis, Missouri
Booth Nos. 60–61

A display of new and essential apparatus, particularly for the biological sciences, includes recent handmade micro-tome knives of the double hollow ground design, a new series of micro-dissection instruments, and dehydration apparatus for small batch processing. Suggestions and recommendations for the development of new laboratory instruments will be discussed with those interested at our booth.

Guests at the Science Exhibition are cordially invited to visit our new building located at Nineteenth and Olive Streets. Among the many new facilities are a modern show room where new apparatus may be thoroughly examined and also a modern chemical laboratory, complete with laboratory furniture and equipment in our display.

American Medical Association

Chicago, Illinois
Booth Nos. 38–39

This exhibit shows the significance of the work of the Council on Physical Medicine and the Council on Pharmacy and Chemistry in the investigation of products intended for therapeutic purposes and the interpretation of these efforts from the standpoint of human welfare.

American Optical Company

Buffalo, New York
Booth Nos. 153–154

The Scientific Instrument Division of American Optical Company, formerly Spencer Lens Company, will exhibit: the new Phase Microscope, a recent research development; a new Metallurgical Microscope with Vertical Illuminator; and a Polarizing Microscope in which Polaroid of optical quality replaces calcite. Other standard microscopes and instruments of the well-known Spencer quality will be on hand. Messrs. J. J. Host, W. E. Folland, G. W. Frid, J. P. Baker, and C. M. Osborne will be in attendance to discuss any optical questions presented.

The Blakiston Company

Philadelphia, Pennsylvania
Booth No. 63

The Blakiston Company have prepared an attractive exhibit of their textbooks and reference works. Important new texts in the undergraduate sciences will be announced. Every science teacher will be interested in the new Hackh-Grant's *Chemical dictionary*, reprinted with changes and additions to include the latest data, among which is considerable material on atom structure, fission, disintegration, and the resulting nuclei. Other authentic Blakiston books of timely interest are Stranathan's *The "particles" of modern physics*; Hector, Lein, and Scouten's *Electronic physics*; *The Harvard books on astronomy*, edited by Dr. Harlow Shapley and Dr. Bart J. Bok, Harvard College Observatory; *Handbook of microscopical characteristics of tissues and organs*, by Karl A. Stiles—an outline course which is finding ever-widening favor among teachers of biology interested in identification studies. Chemistry teachers will also be interested in the new edition of Pregl's *Quantitative organic microanalysis*, revised and edited by Dr. Julius Grant. Textbooks for full-term, semester, or briefer courses in the fields of chemistry, physics, and the biological sciences will be on display. Teachers are invited to discuss any textbook problems or matters pertaining to new manuscripts with the Blakiston representatives at the booth. Those in charge will be T. A. Phillips, H. W. Fry, J. B. Lackey, and J. Losacco.

The Jaques Cattell Press

Lancaster, Pennsylvania
Booth No. 149

The Jaques Cattell Press has been organized now for 5 years and this is the first opportunity it has had to really show what it has planned to do in the way of publishing authoritative scientific books of a nontechnical character. We have had a great deal of encouragement in scientific circles, and feel that we are accomplishing what we set out to do. We have published 50 volumes, but there is much important material to be written and published, and we hope to encourage more manuscripts to be written. We shall exhibit the books which we have published, samples of the circulars which we get out. We shall discuss with authors who are interested in our plans for the future on circularization and methods of distribution. There will be contained in this exhibit the 3 directories edited by Jaques Cattell: *American men of science*, *Leaders in education*, and *Biographical directory of American scholars*. Also a new company will show one or two books, called the Heck-Cattell Publishing Company, which will in the main specialize in textbooks, plans for which can be discussed at our booth. Attendants at the booth will be Mr. Jaques Cattell and Mrs. Ruth H. Little.

Chicago Apparatus Company

Chicago, Illinois
Booth No. 97

This organization, manufacturer of physics equipment for use in elementary schools, high schools, and colleges, has been in business continuously under the same management since 1908. The company is planning to exhibit a number of new items of equipment and improvements over classic models. Special attention will be given to an improved model of Singerman's Color Apparatus, which should prove of interest to those working with color and light. The display will also include a number of items for the chemist: a new water bath, a Barnstead Demineralizer, analytical balances, the justly popular Lindberg Engineering line of heating equipment, and the new Precision Flask Heater. The exhibit is expected to be manned continuously by at least two men from the Chicago Office who will be prepared to discuss any questions regarding the equipment. Catalogues and other literature covering complete lines of all standard brands of laboratory equipment will also be available.

The University of Chicago Press

Chicago, Illinois
Booth No. 43

There will be a cooperative exhibit of scientific books from 18 University Presses. Participating Presses are: University of California, Chicago, Collegiate Press (Ames, Iowa), Columbia, Cornell, Duke, Harvard, Johns Hopkins, Michigan, Minnesota, Oklahoma, Oxford, Princeton, Rutgers, Stanford, Washington (Seattle), Wisconsin, and Yale. Mrs. L. B. Shuler and Miss Shirley Freshman, of the University of Chicago Press, will be exhibitors.

Clay–Adams Company, Inc.

New York, New York
Booth Nos. 155–156

The Clay–Adams Company, Inc., exhibit will include particularly displays of various groups of Medichrome Slides on tropical medicine, normal histology, ophthalmology, and other selected subjects. There will be other Kodachrome items such as S V E, Spencer, and TDC Projectors, Kodachrome view boxes, and cabinets. The laboratory items will include centrifuges, hematology equipment, and other material of interest to physiologists, anatomists, etc. The third group of items will include teaching material such as anatomical charts, mounted skeleton, demonstration skull, etc.

The Coleman and Bell Company

Norwood, Ohio
Booth No. 66

The exhibit of The Coleman and Bell Company, Manufacturing Chemists, will feature a display of laboratory reagents, including inorganic and organic chemicals, biological stains, chemical indicators, and solutions. A number of new items developed during the war will be shown.

Thomas Y. Crowell Company

New York, New York
Booth No. 62

A comprehensive showing of college textbooks will be seen in the Thomas Y. Crowell exhibit. It will include a full selection of books from their college list in the fields of chemistry, political science, geography, sociology, economics, and business administration. Chemistry books will be featured at the exhibit, and along with already published texts in this field the Crowell Company plans to have dummies and possibly proofs of four new chemistry texts available for inspection. These books—*Basic college chemistry*, by Joseph A. Babor; *Semimicro qualitative organic analysis*, by Nicholas D. Cheronis and John B. Entrikin; *Physical chemistry*, by Herschel Hunt; and *First year qualitative analysis*, by Carl J. Likes and Aubrey E. Harvey—are now in preparation and will be available for use next fall.

Denoyer–Geppert Company

Chicago, Illinois
Booth Nos. 46–47

The Denoyer–Geppert exhibit consists of Visual Teaching Aids for the biological sciences. A large selection of wall charts in the fields of anatomy, botany, and zoology; models of human and animal anatomy and plant morphology; Kodachrome slides concerning the science field; human and animal skeletons; museum mounts for zoology and botany; astronomical globes; meteorology charts; and many other items will be shown. Most of these materials are manufactured or prepared in the company's plant in Chicago. This organization is prepared to help plan a coordinated set of Teaching Aids for any course or department so that a maximum of teaching value can be obtained for a minimum of cost. Teachers are invited to discuss their Visual Teaching Aid problems with representatives attending the exhibit.

Eastman Kodak Company

Rochester, New York
Booth Nos. 53–54

The theme of the Eastman Kodak Company exhibit will be "Functional Photography"—spectrographic analysis, electron microscopy, microradiography, X-ray diffraction, stress analysis, instrument recording, photo layout, training films, and photographic copying papers. A great variety of photographic equipment and materials—paper, film, and chemicals—used for scientific research will be part of the exhibit, and will be available for examination and discussion. *Functional photography*, a 20-page booklet, will be distributed, and literature describing the application and technic of many of the scientific uses of photographic material will be available. Examples showing the result of the use of photographic materials in scientific research will be displayed in the exhibit and will indicate to some extent the many possibilities for applying photographic principles to scientific problems. Time spent at the Kodak "Functional Photography" exhibit reviewing the many examples of photography, other than the more elementary uses, will be time well spent. Special Kodak representatives will be in attendance to serve you.

J. W. Edwards, Publisher, and Edwards Brothers, Inc.

Ann Arbor, Michigan
Booth No. 98

This exhibit features the reprints of basic scientific and technical books and periodicals originally published in Germany during the war. The J. W. Edwards Catalog No. 5, available at the exhibit space, lists some 500 such books republished by license of the U. S. Office of Alien Property Custodian. Examples of the facsimile reprints of 137 foreign scientific and technical periodicals published abroad during the war years (1939–40 to date) will be on display. A catalog will be distributed. In addition, examples of Edwards Brothers, Inc., education and industrial printing are to be shown and will be represented by samples of preliminary class texts, laboratory manuals, etc., and by parts of manuals and similar industrial publications. The space is to be identified by a large photo montage of industrial scenes keyed to the scientific and technical materials on display. The manner in which these important enemy research books and periodicals have been placed in the hands of American scientists will be graphically portrayed by another part of the exhibit. The Edwards representatives in attendance are prepared to discuss the materials offered and to take orders for desired books and periodicals.

The Encyclopaedia Britannica

Chicago, Illinois
Booth No. 66

A simulated classroom, with periodic showing of classroom films on a screen, will form the exhibit of Encyclopaedia Britannica Films. A scale model of a teacher and four "model" children sitting in schoolroom chairs makes up a prominent part of the exhibit, which has been designed to show Association members how classroom films should be used in educating students. The screen itself will be hung on the rear wall of the classroom. In front of it will be a blackboard and a painting of the teacher's desk, while the teacher will stand beside the board as though instructing the pupils. Films to be shown in the exhibit will be 16-mm. sound Encyclopaedia Britannica classroom films, which consist of some 500 different subjects designed to provide audiovisual instruction to students from first grade through college. Films for science courses and social sciences make up the bulk of the different subjects covered by the classroom motion pictures produced by Encyclopaedia Britannica Films in cooperation with leading educators of many principal American universities and colleges.

Fordham University Press

New York, New York
Booth No. 87

Fordham University Press is devoted to the publication of textbooks at the college level and of general works in the fields of literature and the arts. A representative selection from the entire active list is displayed. Among these a featured item is *College physics*, an undergraduate text in both classical and modern physics. The chapters on atomic fission are up to date and thorough. There is also emphasis on the needs of premedical and pre-engineering students. Also featured is *Fact and fiction in modern science*. This investigation of modern science research has had four printings in Eire, two in the United States, and is being translated into several foreign languages.

Gamma Instrument Company, Inc.

New York, New York
Booth No. 44

The exhibit of the Gamma Instrument Company, Inc., will feature a few of the scientific apparatus which this company has introduced during the past few years. Foremost among them will be the Gamma Automatic pH Meter. This is a unique development incorporating the latest achievements of electronic design. It combines great accuracy with extremely simple operation. Another new Gamma development is the Microflex Photomicrographic Camera, which employs for the first time the mirror reflex principle in an independent camera for microphotographic purposes.

General Biological Supply House

Chicago, Illinois
Booth No. 45

This year the General Biological Supply House will feature two new items and exhibit many which have been revised or supplemented, as well as some already familiar materials. One of the exhibits especially to be featured will be water-clear plastic blocks in which biological specimens are embedded. Sponges, echinoderms, arthropods, embryos (such as the pig), and small skulls have all been so mounted. These blocks can be roughly handled, are light in weight, and without special care will be excellent demonstrations for years. Orders can be sent in for the embedding of either your own or our specimens. Our second special demonstration is a blood-typing kit which provides a simple and very quick method for the student to observe and type his own blood. Powder, and not serum, is used. This powder, aside from being less expensive, makes the typing much easier and gives a definitive test in one minute. This kit will be demonstrated at our booth. Kodachromes covering many biological fields will be projected for inspection. Microscope slides from diatoms to whitefish will be visible by microprojection and microscope. Copies of our publication, *Living specimens in the school laboratory*, will be on display, as well as new editions of our Bacteriology and Microscopy booklets.

Gradwohl Laboratories

St. Louis, Missouri
Booth No. 71

This exhibit will show facts regarding blood-grouping sera, particularly the Rh factor. These laboratories are prepared to furnish the following: 1) tested laboratory reagents, 2) a monthly digest of laboratory literature, and 3) training school for laboratory technicians. Full literature will be furnished at the booth.

The Graf-Apsco Company

Chicago, Illinois
Booth No. 110

An outstanding example of what can be done in rebuilding used equipment is demonstrated in the exhibit of the Graf-Apsco Company. Here are shown microscopies from the simplest to the most complete research models. Rebuilding microtones is also a highly specialized feature of this firm. See what can be done in restoring preciseness to otherwise expensive worn-out equipment. The Graf-Apsco Company is the originator of rebuilt microscopes in America. Its excellent service in restoring and prolonging the life of microscopes and microtomes is unchallenged over the years. Also in the exhibit are dissecting instruments and other essentials in the teaching of biology.

W. A. Hammond Drierite Company

Xenia, Ohio
Booth No. 145

Our exhibit will illustrate many applications for Drierite, the desiccant used in industry, commerce, laboratory, and the home for drying solids, liquids, and gases. Samples of Regulate Drierite, Du-Cal Drierite, Indicating Drierite, and Moulded Drierite will be on display. The color change from blue to red which takes place in Indicating Drierite on absorbing moisture will be demonstrated. Various containers charged with Drierite and used for drying closed compartments, chemical balances, refrigerants, dual window spaces, home closets, and basements may be inspected. Photos and data will be available to illustrate industrial twin-tower drying installations for drying air, gases, and organic liquids. Also exhibited will be a Cryochem apparatus used for dehydrating biological serums without injury, the Anhydrostil—a convenient laboratory and production device for drying organic liquids in the vapor phase, and a portable unit combining blower and Drierite cartridges to make dry air readily available at scattered locations as needed. Dr. W. A. Hammond and Mr. J. L. Ledeen will be at the booth to offer technical assistance to visitors.

Laboratory Equipment Corporation

Benton Harbor, Michigan
Booth No. 122

The exhibit will consist of a power unit, and combustion furnace capable of attaining a temperature of

3,000° F. This furnace was especially designed to give economical performance at a continuous operating temperature of 2,600 to 2,700° F., this being the required temperature for combusting of samples in the new sulphur analysis method as described by A.S.T.M. In conjunction with the combustion furnace, the sulphur-determining apparatus, capable of giving a 3-minute sulphur determination of irons and steels, will be displayed. Having introduced and developed the Volumetric Carbon Determinator in this country, we are also showing the very latest 2-minute Carbon Determinator. Samples of lamp-blown glassware will be displayed, and certain ceramic parts used in metallurgical analyses will be shown as examples of the type of glassware and ceramic parts this company is capable of manufacturing for the trade.

The Macmillan Company

New York, New York
Booth Nos. 143–144

The book exhibit sponsored by the Macmillan Company consists of approximately 700 titles, including publications of the Cambridge University Press. In addition to undergraduate and graduate textbooks and reference works there will be a large number of technical and scientific books of interest to the general reader. Books in the fields of various hobbies and avocations—photography, gardening, radio, outdoor life, and others—are represented, as are books of special interest to young readers. The major classifications are Agriculture, the Biological Sciences, Chemistry, Engineering, History and Philosophy of Science, Home Economics, Mathematics, Medical Science, and Physics. Representatives of the Macmillan Company at this exhibit are Mr. J. B. Bennett, Jr., Mr. Tyler Buchenau, Mr. J. G. Case, Mr. Sidney R. Crawford, II, Mr. Frank A. Driskill, and Mr. Joseph G. Sutton, Jr.

McGraw–Hill Book Company, Inc.

New York, New York
Booth Nos. 157–158

In the McGraw-Hill exhibit you will find several hundred texts and reference books representative of our publishing programs in virtually all fields of science, engineering, and technology. Many of these books are new publications, constituting the most up-to-date and authoritative texts available and frequently reflecting recent advances resulting from wartime experience. In addition to these latest contributions, the exhibit contains many revisions of standard texts, handbooks, manuals, and other important contributions to the literature of various fields which will be of vital interest to teachers, research workers, and technicians. The following members of the McGraw-Hill Book Company staff will be in attendance: Curtis G. Benjamin, vice-president in charge of the Educational Division; Harry P. Graves, vice-president and manager of the College Department; Edward E. Booher, vice-president in charge of Technical and Business Education, and School Departments; and Kenneth B. Demaree, editor, Physical and Natural Sciences.

G. & C. Merriam Company

Springfield, Massachusetts
Booth No. 151

The G. & C. Merriam Company exhibit will consist of a sample display of the various publications of the company which we list herewith: Webster's *New international dictionary* (2nd ed.), Webster's *Collegiate dictionary* (5th ed.), Webster's *Dictionary of synonyms*, and Webster's *Biographical dictionary*. In addition, there will be displayed for distribution copies of various pamphlet material dealing with the instruction in, and the use of, the various books mentioned above. Souvenirs will be provided.

The C. V. Mosby Company

St. Louis, Missouri
Booth No. 121

The C. V. Mosby Company, scientific publishers, will exhibit a diversified line of publications. All parties attending the St. Louis meeting are cordially invited to look over the Mosby books and browse through our publications. Courteous attendants will be available to assist. Among the newer publications to be displayed will be the following: Kleiner's *Human biochemistry*, Main's *Synopsis of physiology*, Hoskins-Bevelander's *Essentials of histology*, Arnow-Reitz's *Organic and biological chemistry*, and Dougherty-Lamberti's *Textbook of bacteriology and immunology*.

National Geographic Society

Washington, D. C.
Booth Nos. 58–59

The National Geographic Society's exhibit presents a backdrop display of maps, supplements of the *National Geographic Magazine*, and striking natural color photographs from the latter, projected by an automatic slide machine. Among the maps shown will be copies of charts similar to those which played an important role in winning World War II. Several million of the Society's charts were used by United Nations Armed Forces from the Pentagon at Washington to the battlefields of the European and southern Pacific theaters. On two occasions, the Society records, members of our forces navigated long distances to safety with National Geographic maps their only guides.

National Research Corporation

Boston, Massachusetts
Booth No. 84

The Alphatron Vacuum Gauge, operating by the ionizing power of alpha particles from a radium source, measures pressure of any gas or mixture from 0–10 mm. of Hg with linear response. Sensitive and accurate in reading, but durable and simple for industrial use, this gauge, just released from the development laboratories of National Research Corporation, covers an important pressure interval which has not been adequately gauged heretofore. A working model demonstrates the action of the gauge, and a cutaway model shows the simple construction and principle of operation. Another item in the exhibit is a packaged pumping and gauging system capable of producing a vacuum of approximately .000001 mm. of Hg in an 18-in. bell jar. This piece of equipment was developed for evaporating low-reflective magnesium fluoride coatings on optical elements and metallic reflective coatings on glass and plastics. By a revision of the accessories mounted on the baseplate, the evaporator becomes a versatile laboratory tool for electronic research. Introduction into the evacuated chamber of electric currents, high voltages, liquids or gases, and controllable motion through specially designed seals gives the experimenter or tube designer an opportunity to work with continuous and measurable variables. Other items on display will be thermocouple and ionization gauges and controls and a 2-in. all-metal diffusion pump.

Purdue University

Lafayette, Indiana
Booth No. 41

This exhibit will feature germanium semi-conductors and crystal rectifiers (results obtained in connection with and under Contract OEMsr-362, Office of Scientific Research and Development; Purdue Research Foundation case No. 184). Various samples of germaniun semiconductors with widely different electrical properties, such as resistivity and thermoelectric power, will be exhibited. Different types of crystal rectifiers made from these materials—low and high frequencies and high back-voltage rectifiers—will be exhibited and their characteristics demonstrated with the aid of oscillographs. The change of contact properties of crystal rectifier contact under the action of heat and light will also be shown. This exhibit will be accompanied by charts illustrating the fundamental electrical properties of semi-conductors as a function of impurity content.

W. B. Saunders Company

Philadelphia, Pennsylvania
Booth No. 67

The exhibit includes a complete line of textbooks and reference books dealing with the medical and biological sciences. Of special interest are the following new books: Herrell's *Penicillin*, Mackie, Hunter, and Worth's *Tropical medicine*, Ash and Spitz's *Pathology of tropical diseases*, Masserman's *Principles of dynamic psychiatry*, Cantarow and Trumper's *Clinical biochemistry*, Olson's *Prevention, emergencies and first aid*; and the new editions of Marshall's *An introduction to human anatomy*, Greaves' *Elementary bacteriology*, Frobischer's *The fundamentals of bacteriology*, Millard and King's *Human anatomy and physiology*, Howell's *Textbook of physiology*, and Jordan and Burrows' *Textbook of bacteriology*. The representatives present during the convention are: Messrs. John A. Behnke, O. G. Enstrom, Paul E. Koerfer, Walter S. McKay, H. M. Cook, and A. M. Greene.

The Science Press Printing Company

Lancaster, Pennsylvania
Booth No. 150

The Science Press Printing Company prints about 40 scientific journals, and will have copies of these on exhibit, not only to show the extent of the work of The Science Press Printing Company, but to make it sort of a headquarters for our Editors who are welcome to use our booth at any time. We print many books as well as periodicals and they also will show the printing which emanates from the press. While The Science Press Printing Company has many more journals offered for publication than can be accepted we shall be glad to discuss and be of service to anyone attending the meeting in regard to their printing problems with a view to eventually working with them on printing a journal or book. The Science Press Printing Company during the war period succeeded in keeping a fairly regular schedule. We feel confident for the future because we know the Editors which we are dealing with have complete confidence in our knowledge of the importance of the scientific printed matter. We hope that we can continue to serve science by the printed word for many years to come. Attendants at the booth will be Mr. Jaques Cattell, our president, and one of his printing assistants.

Sparkler Manufacturing Company

Mundelein, Illinois
Booth No. 146

Sparkler Manufacturing Company will exhibit a Laboratory Model Horizontal Plate Filter in operation. The model has sidewalls of glass and visibly demonstrates the efficiency and ease of Horizontal Plate filtration. Also on display, but not in operation, is a stainless steel Laboratory Filter, in standard construction, mounted with pump and motor on a portable stand with ball-bearing casters.

Statham Laboratories

Los Angeles, California
Booth No. 138

The exhibit of Statham Laboratories is designed to bring to the attention of scientists the properties of Statham instruments. The Statham Gage is an unbonded strain gage which is capable of measuring deflections as minute as 0.000008″ and force changes as small as 0.02 oz. This is accomplished without need for expensive electronic equipment. In the simplest case, a flashlight battery, a Statham Gage, and a microammeter are all the equipment required. It will be obvious to the trained worker how such equipment may be incorporated with advantage in research apparatus such as, for instance, dilatometers. The high sensitivity and stability of the Statham Gage enable its incorporation into other instruments which also will be shown. The Statham Accelerometer can measure acceleration with full score range as small as ± 2 g or as great as ± 200 g. The output is sufficient for direct operation of recording equipment without need for electronic amplifiers. The Statham Pressure Pickup enables remote indication or recording of liquid or gas pressures over ranges of pressures as small as ± 2 in. of water or as great 0–10,000 lbs. per square inch.

The Technicon Company

New York, New York
Booth Nos. 64–65

The Scopicon is a unique microslide projection apparatus embodying several innovations which endow it with extraordinary versatility. For small-group study or consultation, it is used in conjunction with a table-mounted dark chamber fitted with 10 viewing hoods. The magnified image is then projected upon a viewing platen housed within the dark chamber. For auditorium or classroom demonstrations, the Scopicon projector unit may be quickly uncoupled from the table and employed for wall-screen projection, achieving brilliantly and evenly-lit images six feet or larger across, even under oil-immersed microscopic powers. This remarkable magnification and even illumination rise from the utilization of a high-pressure mercury-arc light source and a highly efficient optical system. Accessory devices quickly adapt the Scopicon for microphotography. The Autotechnicon is an instrument which automatically processes tissues. All steps in the processing sequence—fixation, washing, dehydration, clearing, infiltration, and staining—are performed according to the requirements of any elected techniques. Fully automatic operation assures unvaryingly uniform results. The Technicon "Lab-aid" filing cabinet has interchangeable drawers for filing either 1- or 2-in. microslides, Kodachromes, transparencies, cards, and up to 4¼-in. lantern slides. The single-bank drawers, moving on smooth-tracking rails, provide the ultimate answer to the pathologist's filing problem. The Technicon Company will also exhibit their Constant Temperature Water Bath and the Technicon Pipette Washer.

United States Public Health Service

Atlanta, Georgia
Booth No. 129

This exhibit is divided into two units. The first of these consists of seven display cabinets containing a series of sixty-three 8 in. × 10 in. colored transparencies depicting the life cycle, geographic distribution, pathology, symptomatology, treatment, and diagnosis of Schistosomiasis. These transparencies are excerpts which have been taken from a more complete film strip about this infection. The adjoining section of the exhibit consists of a projection booth provided with seats, in which three colored-film strips with accompanying recorded descriptive narrations will be shown. These are entitled "Schistosomiasis," "The Laboratory Diagnosis of Schistosomiasis," and "The Identification of the Female Anophelines of the U. S." and will be shown at the convenience of the viewers. The film strips and recordings are being offered to all interested individuals and institutions as aids in the teaching of parasitic diseases. Since this is a relatively new device in the field of parasitology, all comments and criticisms concerning such audiovisual materials will be most helpful in attempting to evaluate them.

Ward's Natural Science Establishment, Inc.

Rochester, New York
Booth No. 69

Ward's Natural Science exhibit will include the Mueller-Ward models of Frog Embryology, Comparative Zoology, Comparative Embryology, and the Wilson-Ward models on the Embryology of the Human Face. Ward's new Plastic Corrosion Preparations will also be on display. These are colored plastic casts of the circulatory system and make a spectacular demonstration. An exhibit of Ward's new Bio-Plastic mounts will also be made. These consist of biological and geological specimens embedded in clear plastic. Ward-Color slides will also be displayed. These are far superior to ordinary Kodachrome duplicates. Other modern teaching materials will be exhibited. A complete set of Ward's catalogues, booklets, and bulletins will be included in the exhibit and members of the staff will be present.

W. M. Welch Manufacturing Company

Chicago, Illinois
Booth No. 70

This exhibit will include: scientific instruments and laboratory apparatus for college, university, and research laboratories; teaching apparatus such as Force tables, Boyle's law, photometers, spectrometers, etc.; instruments such as voltmeters, ammeters, galvanometers, resistance boxes, balances, etc.; a complete line of vacuum pumps; biological laboratory equipment such as specimens, mounts, skeletons, charts, etc.; and a complete line of postwar, American-made instruments especially worthy of consideration at this time for planning for GI training courses.

John Wiley and Sons, Inc.

New York, New York
Booth No. 147

John Wiley and Sons, Inc., will have for examination over 100 titles of its scientific books in such fields as chemistry, agriculture, biology, geology, geography, mathematics, mineralogy, psychology, physics, astronomy, etc. These books will be on display in the Science Library and in Booth No. 147. The booth exhibit will concentrate largely on the latest Wiley publications of particular interest and significance. Among the new books to be shown will be A. Taylor's *Introduction to X-ray metallography*, the second edition of J. Yarwood's *High vacuum technique*, Harry Barron's *Modern plastics*, and *Electron optics and the electron microscope*, by V. K. Zworykin, G. A. Morton, E. G. Ramberg, J. Hillier, and A. W. Vance. Other prominent new books on display will be Gideon S. Dodds' *Essentials of human embryology*, S. C. Prescott, C. A. Winslow, and M. H. McCrady's *Water bacteriology*, J. D. Forrester's *Principles of field and mining geology*, and many others. Anyone attending the meeting will be welcome to inspect these and other Wiley titles on display.

Letters to the Editor

Pectin Intravenously

In his communication under the above title Hueper (*Science*, 1945, 102, 233) commented on our note, "Uronic acids in animal bodies" (*Science*, 1945, 101, 670). We believe he may have overlooked our intent, which was to emphasize the importance, wherever practicable in future biological studies, of differentiating between glucuronic and galacturonic acids rather than masking probably galacturonic values under the designation glucuronic acid.

We suggest that those interested in the use of intravenous pectin should read carefully the complete articles referred to by Hueper as well as others which have appeared in medical literature. Because of space limitations neither our note nor Hueper's could treat this subject adequately.

W. E. Baier, E. F. Bryant, G. H. Joseph,
and G. H. Palmer

Research Department
California Fruit Growers Exchange, Ontario, California

Genetical Studies of the Sesame Flower

A preliminary study of the flower of sesame (*Sesamum indicum* L.) has revealed 33 morphological and 30 color differences among the many varieties and hybrids in the collection of this department. The mode of inheritance of 24 of these basic flower types has been determined, showing simple segregations, modifying factors, complementary factors, multiple alleles, duplicate factors, and five cases of linkage (the first to be described in sesame).

Of particular interest is a type with all five lobes of the corolla completely separated, in contrast to the usual tubular form. Some of the other characters include the colors yellow, red, and purple in different intensities and distributions fused anthers, tuft of hair, double flower, double lip, elongated cells in the foveola, and glabrous.

These flower differences, in addition to supplying a wealth of material for determining the linkages of numerous other characters previously reported (D. G. Langham and Maximo Rodriguez. *Boletin No. 2, Instituto Exp. Agric.*, Caracas, Venezuela, June, 1945) and in study, may be extremely useful in a study of the geographic distribution of sesame with special reference to its place of origin.

D. G. Langham

Instituto Experimental de Agricultura
Caracas, Venezuela

A Possible Source of Atmospheric N_2O

The existence of nitrous oxide (N_2O) in the earth's atmosphere has been established by the discovery and analysis of an absorption band at 7.77 μ in the solar spectrum (A. Adel. *Astrophys. J.*, 1939, 90, 627; 1941, 93, 509). The origin of this gas in the atmosphere is still in doubt, for its presence is not readily explained by the photochemistry of the air. It is the intention, in what follows, to call attention to an apparently plausible and interesting means of accounting for the phenomenon.

In recent examinations of soil air for hydrocarbon content, M. W. Kriegel, of the Carter Oil Company, Tulsa, Oklahoma, has found a hitherto unreported component; and on the basis of careful investigation of its properties, he suggests that the gas is very probably nitrous oxide (*Geophys.*, 1944, 9, 447–462). Kriegel points out that "nitrous oxide in the soil is not surprising when it is remembered that the element nitrogen in the form of ammonium salts, nitrites or nitrates is present in fertile soils; and that one method of preparation of pure Nitrous Oxide is according to the equation:

$$NH_4\,NO_3 = N_2O + 2\,H_2O$$

It is also probable that the slow decomposition of commercial fertilizers might account for some of the Nitrous Oxide in farming areas. In connection with the studies of decomposition of vegetation under aerobic conditions, it has been shown by this laboratory that a gas having properties similar to Nitrous Oxide forms a large portion of the condensed fraction."

If, as appears to be the case, it is indeed true that soil air contains N_2O, is it not reasonable to assume escaping soil air to be one source—perhaps the principal one—of the atmospheric nitrous oxide layer?

Arthur Adel

Randall Laboratory of Physics, University of Michigan

The Function of Psychology

These remarks are suggested by reading the article by Captain Jenkins (*Science*, 1946, 103, 33–38), which seems to me too diffuse.

In a certain sense, it may be claimed that psychology is the most important of all sciences, since the future of the human race, and even its existence, depends on the actions of people, and those actions depend on their knowledge and beliefs.

I find myself with certain opinions, including opinions about psychologists. How did I come by them? Partly as the result of teaching, partly from direct experience. Owing to various inventions, such as those of the telescope and microscope, I find myself able to be directly aware of many phenomena which would be imperceptible to my unaided senses. This extension of the senses has been so remarkable in recent years that the range of direct observation or experience has been enormously extended. But a single mind cannot compass all these things, and for the most part I have to depend upon others to see what I might have seen, to hear what I might have heard.

Thus, at the beginning of the century the age of the various geological strata was carefully estimated by competent geologists, but the physicists were presently able to give convincing reasons for increasing these estimates about tenfold, and these results have been meekly accepted by the geologists and biologists. Superimposed, or perhaps I should say underlying, all these observations, direct and indirect—the material of science—is the body of overbeliefs, resulting from tradition, and fed by the *emotions. We cannot escape from these,* or abandon our sense of human values. A great dilemma of modern life results from the fact that some or many of the ancient beliefs do not accord with the findings of science, and people live, as it were, in two worlds, one of practical realities, and one of the emotions. The reconciliation of these discrepancies is one of the great tasks for the future. What have the psychologists to say about this? What has science to say about it? What is the verdict of religion?

The great tasks of education are twofold: to educate the mind, or the senses, so that the findings of science may be available to all, not as rigid dogma but as reasonable approximation to truth, certain to be largely extended and modified in the future; to educate the feelings, the social senses, so that the welfare of all mankind becomes in a measure that of every individual, the happiness of all the happiness of each.

T. D. A. Cockerell

Box 411, Palm Springs, California

Water Loss From the Respiratory Tract in the Subtropics

The interpretation of Dr. Burch's valuable data (*Science*, 1945, 102, 619–620) on water loss from lungs, in so far as this is a function of the temperature and humidity of the inspired air, would be facilitated, I believe, had he used values of humidity in terms of physiological saturation deficit rather than of relative humidity. Physiological saturation deficit, a term I am now inventing or reinventing, is the difference between the absolute humidity of the air and what the absolute humidity would be at saturation at body temperature. Since it would be impossible for the lungs to evaporate any moisture into air already saturated at body temperature, the PSD represents the opportunity for evaporation from the lungs.

I have derived the PSD's for the temperature and humidity conditions presented by Dr. Burch, with the following results. It is convenient to work in terms of the deficit of the vapor pressure of the air relative to that at saturation at body temperature, 6.2 mb. The PSD's for the conditions under which most of the measurements were made (20.0 to 21.1° C. and rel. hum. 55 to 60 per cent) were 4.7 to 4.9 mb. The PSD for the cool, foggy air (15° C., 97 per cent rel. hum.) was 4.6 mb, and of cool, dry room air (15° C., 60 per cent rel. hum.) 5.2 mb. Since these humidity conditions differ by only 4 to 8 per cent from the standard test conditions it is natural that they influenced the rate of water loss relatively little.

The hot dry air (50° C., 18 per cent rel. hum.), though its PSD was, at 4.0, less than under the standard conditions, increased the rate of water loss. Perhaps this was owing to increased heart action and respiration to be expected in such a high temperature, for the expired air had a PSD of 1.0 mb, or 3.0 mb lower than the inhaled air, which was the same as the reduction in PSD from the 4.7 to 4.9 of inspired air to the 1.7 mean of exhaled air in the general test. The hot moist air (50° C., 49 per cent rel. hum.), with a PSD of only 0.2, naturally, reduced the rate of water loss considerably. Indeed, it appears, from the fact that the expired air (at 39.4° C. and 74 per cent rel. hum.) had a PSD of 1.0 mb, that there was condensation of vapor in the body!

Charles F. Brooks

Blue Hill Meteorological Observatory
Harvard University

Rediscovery in the Vitamin A Field

It is becoming increasingly troublesome to verify whether or not one has made a discovery, or merely a rediscovery. However, if the matter seems worth publishing, courtesy surely demands the admission that no thorough literature search has been made when this is so.

According to recent communications to this journal (*Science*, 1945, 101, 585; 102, 158) the blue colour developed on treating vitamin A with various acid earths has been independently discovered three times, by Lowman, by Meunier, and by Emmerie and Engels. [For references, see *Science*, 1946, 103, 175.] It is possible to add a fourth and probably the original discoverer to the list, namely Takahashi (K. Takahashi and K. Kawakami. *J. chem. Soc. Japan*, 1923, 44, 590), who published the observation no less than 16 years before the earliest reference previously quoted.

Similarly, the fact that the greater part of the vitamin A of fish-liver oils is present as fatty acid esters has been independently discovered at least three times. K. Hickman (*Ind. eng. Chem.*, 1937, 29, 1107) confirmed the observation by analytical molecular distillation but referred to no earlier work. In a recent paper from the same laboratories (H. Koscher and J. Barter. *Ind. eng. Chem.* (Anal. ed.), 1945, 17, 499), priority is accorded to L. Reti (*C.R. soc. Biol.*, 1935, 120, 577), who used partition methods. The original observation, also using partition, was published by A. L. Bacharach and myself seven years earlier (*Quart. J. Pharm.*, 1928, 1, 539).

E. Lester Smith

Glaxo Laboratories, Ltd.
Greenford, Middlesex, England

Freedom of Science in Soviet Union

We followed with great interest the exchange of views between Dr. Karl Sax, of Harvard University (*Science*, 1944, 99, 298–299; 1945, 102, 649) and Dr. Anton R. Zhebrak of Timiriazev Agricultural Academy, USSR (*Science*, 1945, 102, 357–358).

K. Sax wisely leaves unchallenged some purely political questions raised by A. Zhebrak. If a one-party state with a system of election when the population has no choice of candidates and must vote a straight communistic ticket is called "a highest form of democracy," it is clear that American and Soviet concepts of democracy are so far apart that there cannot be a constructive debate on that point.

Let us turn to another statement by A. Zhebrak, "that science can be free in a centralized socialistic state" and that the opinion of K. Sax that "science must conform to political philosophy" in USSR is wrong.

We must state most emphatically, on the basis of our personal experience in USSR, that K. Sax is absolutely right. All groups of population in Soviet Union are living under terrific political pressure and the state is regulating everything and interfering in everything, and this cannot be different because the state is supreme and absolute and the individual is just nothing. Freedom, as Americans understand it, is simply nonexistent in USSR. The scientists are not exceptions to a general rule, although they enjoy some privileges and their standard of living is much higher than that of other less fortunate subjects of Soviet Union.

Let us take a glaring example, about which A. Zhebrak keeps a modest silence. We mean the case of academician N. I. Vavilov, who "was arrested by NKVD in the summer of 1940 and has been kept in custody since then" (*Chronica Botanica*, 1941, **6**, 429). We have now reliable information that Vavilov died in a concentration camp in Siberia in 1942.

We can understand the reasons for Zhebrak's avoiding the issue. What ironical commentary on the freedom of science in USSR is the fact that one of the most famous Russian scientists, who rendered outstanding service to his country and who was so respected in USA, could be put to a certain death in a concentration camp for no other reason than his scientific views were found not to be in conformity with Marxian ideology (Vavilov–Lysenko controversy)! But the most disturbing fact is that the case of Vavilov is by no means an exception. We know that hundreds of less-known Russian scientists are dying slowly in Soviet concentration camps which can compete quite favorably in atrocities with Belsen, Dachau, and other Nazi horror camps. Although we can cite the names of some of these unfortunates we have some very sound reasons not to do this. The first rule of all totalitarian states—silence is golden—is known not only to A. Zhebrak but also to us. We talk about Vavilov only because we are sure that he is dead.

K. Sax asks "why and how Vavilov died." He can find the answer to his second question in a book written by a well-known Russian scientist, Prof. Chernavin, *I speak for the silent*, which gives a true and very vivid picture of the life of scientists in the Soviet Union and explains why their careers end sometimes in jail. Prof. Chernavin spent considerable time in various concentration camps and eventually escaped from one of them to Finland, so he can be considered a specialist on this subject.

Although probably 12–15 years elapsed since Chernavin's book was written, our information gathered from the persons who returned only recently from Soviet Union convinced us that nothing was done there to promote the cause of freedom in general and freedom of science in particular. A few privileges granted to scientists are not enough to change the general picture. And although A. Zhebrak describes very eloquently the progress of science, especially in his field (plant genetics), we earnestly believe that the achievements of scientists in USSR would be much more impressive if the fundamental conditions for that—freedom of scientific research and freedom of discussion and criticism—existed in that state.

We are afraid that A. Zhebrak hardly will understand us. We are probably talking again different languages although we both were born in the same country. And this fact is significant in itself. The difference in concepts of such fundamental things as democracy and freedom, which appeared only after the revolution of 1917, is the result of 28 years of most persistent, shrewd, and vicious propaganda to which all citizens of the Soviet Union are subjected day after day. It is interesting to note that even scientists are not immune to this scourge of our time.

VLADIMIR C. ASMOUS
Arnold Arboretum, Harvard University

Present Status of Foreign Herbaria and Museums

Although the war has brought about tremendous advances in most branches of science, it has resulted in irreparable losses to systematic biology. Losses of some of the reservoirs of basic data of these sciences, the herbaria and museums that have been destroyed or damaged, are like the results of the fall of the legendary Humpty-Dumpty—all the king's horses and all the king's men cannot restore them. Similar specimens may be accumulated to replace those destroyed, if the places from which they came have not been completely altered, but if a species has been based on a specimen, there is no conceivable way of filling its place if it is lost. Much destruction of this sort has occurred during the war just ended and is likely to continue to occur because of a lack of interest during the period of reconstruction, and because of loss and lack of replacement of competent curatorial personnel.

Systematic botany and zoology differ from most other branches of biology in that the sources of their data can be preserved in relatively permanent form in herbaria and museums. Collections of specimens, together with libraries in which are preserved the records of the circumstances under which the specimens were collected as well as the results of hundreds of years of study, form the essential equipment of the biological systematist. With these collections and libraries as the reservoirs of data, the student may identify plants and animals, construct classifications, work out comparative morphology, stabilize nomenclature, reconstruct phylogeny, plot and interpret geographical distribution, and with newer techniques study the structure and behavior of populations. Since the collections are carefully preserved and filed, the work in these fields does not rest merely on observations of ephemeral phenomena recorded by human hand but on the actual material observed, which may be consulted and verified at will by future workers.

Classification and the identification of material is also fundamental to all other types of biological research. It is the foundation of the language used by the workers in other fields by which they can communicate and compare their results. The classification of the plant and animal kingdoms has well been compared to the map plus directory of a great city.

Within certain limits systematic biologists have traditionally carried on almost ideal cooperation. The doors of herbaria and museums have always been open to all qualified workers from whatever institution or country. Material has been lent back and forth in great quantity to facilitate the work of those who cannot travel extensively or who need to study more specimens than they have at hand. Exchanges and deposits of specimens build up the large collections needed for adequate study. Anyone who obtains a specimen and places it in a museum is assisting with the work of countless future workers, most of whom he will never see. This is the spirit upon which all science is founded, and it is especially well developed in the oldest branch of biology, systematics.

The losses sustained in the war are thus not of merely local interest to the institutions or countries which have incurred them. They are losses to biology as a whole, and all workers in systematic biology may well be seriously concerned.

It is our purpose as botanists here to call attention to the fact that no concerted effort has been made or is being made to ascertain the extent of these losses, the fate of specimens borrowed from the American institutions, or the steps needed to avert further losses and to repair, in so far as possible, the damage that has been done. The need for such an early inventory should be readily appreciated, and its practicality can hardly be denied in the face of the sending abroad of specialists commissioned to make inventories in the interest of salvaging all sorts of things: objects of art, historical documents, and monuments as well as military and industrial data. With further delay it will be a peacetime "too little and too late."

Systematic botany has traditionally been ill-supported, and most accomplishments over and above routine duties have been the result of the personal initiative of the botanists, and at their own expense or, rarely, at the expense of wealthy benefactors. The task of making an inventory of the losses sustained by, and the present condition of, botanical institutions in war-torn countries, however, might well be considered a legitimate project for a governmental agency. Because of the difficulties in travel, the expense involved, and the disagreeable living conditions in the countries concerned at this time, it is likely that no one would care to undertake such a task on his own initiative. Restrictions on foreign travel would, moreover, make it absolutely necessary that such a project have active governmental backing especially authorized in the Department of State. Obviously, no effort should be spared to secure for such work American specialists, both in cryptogamic and in phanerogamic taxonomy, technically qualified by a comprehensive knowledge of botanical history and by broad experience in herbarium practices. The task is scarcely one to be left to persons lacking these qualifications who may be found within the region.

F. RAYMOND FOSBERG and WILLIAM W. DIEHL
Plant Industry Station, Beltsville, Maryland

Recent Contributions to the Theory of Random Functions

There is a rapidly growing interest in statistical problems where one has not to deal with a single numerical random variable or a finite collection of them, but instead, with an infinite sequence of numbers given at random, or a continuous random function. One thinks of the coordinates of a particle in the Brownian motion, or the path of a molecule in a gas, or the "noise" potentials in electrical machines, as being random functions in this sense.

The recent work in this field provides an excellent example of the impediment which the common irrelation between allied disciplines may place in the way of scientific advance. A large fraction of the methods and ideas of this subject has been rediscovered since 1940 by physicists and electrical engineers, almost wholly unaware that the same problems had been raised and solved in the mathematical literature a decade before. What differences exist in treatment or proof are either notational, or minor ones dictated by the traditional opposition between the physicist's ability to make physical intuition bolster an heuristic argument and the mathematician's demand for maximum rigor and generality.

The particulars are these: In a series of papers, the results of which have been summarized (N. Wiener. *Acta Math.*, 1930, 55, 117–258; R. E. H. C. Paley and N. Wiener. *Amer. math. Soc. Colloq. Publ.*, 1934, 19), N. Wiener develops a theory of Gaussianly distributed random functions, both in the wholly independent case with a "white" spectrum and the more general one with an arbitrary "power spectrum." He derives a general formula, in the form of a definite integral, for calculating the average of any function or functional of one or two such random functions—or any number, by obvious extension (*Amer. math. Soc. Colloq. Publ.*, 1934, 19, 152). The discussion proceeds from a theory of formal Fourier series with Gaussianly distributed coefficients (pp. 147, 151). This is called the "Method of Rice" by M. C. Wang and G. E. Uhlenbeck (*Rev. mod. Phys.*, 1945, 17, 323–342) in view of the extensive use made of it in S. O. Rice's review of 1944 (*Bell Syst. tech. J.*, 1944, 23, 282–332; 1945, 24, 46–156).

All of the fundamental methods presented by Rice, except for the discussion of the shot effect, are to be found in this work of Wiener. A large part of the special results may be obtained easily by substituting in Wiener's general formula and evaluating or approximating the resulting definite integral by the usual methods of function theory. To this class belong, for example, the results of Sections 3.1 and 3.2 in Rice on the distribution of the values of the noise at various times, and those in Part IV on the average of various properties of the response of nonlinear devices to Gaussian noise. Indeed, the fundamental formula of the "correlation function method" (4.07, p. 132), ascribed to Van Vleck and North (1943) with references to Fowler and Rice (1942) and Fränz (1941), is Wiener's formula for the case of a function of two random functions.

It is, of course, true that much of this recent work has constituted a real advance. One need only cite the important work of Kac on zeros of random functions and that of Rice and others on the response of nonlinear devices with random inputs confined to narrow-frequency bands, the low-frequency component of the response, envelopes, etc. On precisely this account it is a greater pity that this further work could not have commenced when the basis was first obtained by the pure mathematician, in which case we should be a decade further today.

It is worth remarking in this connection that certain recent mathematical papers of R. H. Cameron and W. T. Martin on the evaluation of Wiener integrals (*Trans. Amer. math. Soc.*, 1945, 58, 184–219) are highly relevant to nonlinear noise problems.

N. Levinson, W. Pitts, and W. F. Whitmore
Massachusetts Institute of Technology

A Publicity Victim

In my book, *The natural gardens of North Carolina* (pp. 28 and 371), I reported that "In India there is a superstition that tea made from the leaves of the plant (*Centella Asiatica*) acts as a brain stimulant." Recently this story went out as a news release from the North Carolina Department of Conservation with the word "superstition" omitted and with my name introduced in such a way that, from numerous letters received, many people were induced to not only believe the story but to believe that I believed it.

In every communication in which I have related this story, I have called it a superstition. And to have the publicity people, by implication, get one lined up in support of a superstition becomes a serious matter.

Fortunately most scientists have so frequently suffered from publicity misrepresentation that they will be skeptical as to the authenticity of such a story. An occasional extreme examples of how tortuous publicity operates may help keep them on their guard. However, in this instance there was no chance given to prevent this unfortunate twist in the writer's relation to a botanical superstition.

B. W. Wells

North Carolina College of Agriculture and Engineering, Raleigh

Blood Group Factors and Ethnic Relationships

Upon the basis of certain extremely interesting and valuable findings concerning the frequency distributions of certain blood group factors among the ethnic groups of mankind Dr. A. S. Wiener (*Science*, 1946, 103, 147) criticizes a diagram (Fig. 18) which appears in a recently published book of mine (*An introduction to physical anthropology*). Dr. Wiener writes: "In view of these findings [on the blood groups], the Australian aborigenes (*sic*) appear to be more closely related to the Mongoloid group than either the Caucasoid or Negroid groups, and the diagram should therefore be revised accordingly."

That Dr. Wiener would consider, as he appears to do, blood group factors alone sufficient to indicate the closeness of the genetic relationship between various groups of man is to me nothing short of astonishing. I had thought that all students of the subject, including Dr. Wiener, were agreed that the inferences drawn from such data could, at most, be regarded only as suggestive. I would be the last to underestimate the potential value of the blood group factors in helping us to untangle the skein of hominid ethnic relationships, but I cannot see that any useful purpose will be served by making these factors bear more than they can carry. As I have written in the book to which Dr. Wiener refers: "The non-adaptive, non-selective nature of the blood group genes renders them of great potential value in the tracing of ethnic relationships. It is, however, not to be expected that it will be possible to solve anthropological problems by merely turning to blood group tables, as one would look up a definition in a dictionary. This is particularly worth emphasizing in view of the fact that neither the evolutionary nor the ethnic implications of the blood groups can as yet be said to be quite clear" (*op. cit.*, p. 134).

I am convinced that the problem of human ethnic relationships will be most fruitfully attacked by the use of genetic methods of analysis, and that the blood group factors will play an important part in that attack, but *in conjunction with the analysis of a good many other characters, the genetic behavior of which is more or less understood.* Taken alone, blood group factors will not tell us very much, and any attempt, at the present time, to erect or criticize a classification of the ethnic groups of man on the basis of such factors alone would be, to say the least, premature. As Dr. Wiener may possibly have forgotten: "The blood tests have limitations, because peoples of the same race may have widely different distributions, while totally unrelated races may have a similar serological classification" (A. S. Wiener. *Blood groups and transfusion.* (3rd ed.) Springfield, Ill.: C. C. Thomas, 1943. P. 330).

M. F. Ashley Montagu

Department of Anatomy, Hahnemann Medical College and Hospital, Philadelphia, Pennsylvania

Book Reviews

Physical methods of organic chemistry. (Vol. I.) Arnold Weissberger (Ed.). New York: Interscience Publishers, 1945. Pp. vii + 736. (Illustrated.) $8.50.

The emphasis in this first volume of a two-volume collection of monographs is heavily on the physical methods as opposed to the organic chemistry. It should be a valuable reference work for any chemist who wishes to make careful measurements of physical properties. The subjects of the 16 chapters are all determinations which are important in the characterization of organic compounds or for the elucidation of their structures and behavior. All are presented with the authority of genuine experts, and most of them with compassion for the nonexpert. The editing has been successful in eliminating duplication and overlapping. The topics range from measurements which are an everyday task in every laboratory to those which are pretty much a job for a specialist. With the former, the critical discussion of limitations and precision should have much value; with the latter, the reader may at least grasp the significance and the limitations of the technique. Sturtevant's article on calorimetry is a model treatment, covering the field from the refinements necessary for the utmost precision or under extreme conditions to an unprejudiced assay of the value of relatively crude and simple methods, and refraining admirably from an overemphasis of the author's own accomplishments and special fields of interest. The excellent articles on viscosity, osmotic pressure, and diffusivity reflect current interest in high polymers.

The subjects covered are melting, freezing, boiling, and condensation temperatures, density, solubility, viscosity, surface and interfacial tension, properties of monolayers and duplex films, osmotic pressure, diffusivity, calorimetry, microscopy, crystal form, X-ray and electron diffraction, and refractometry.

LOUIS P. HAMMETT

Columbia University

Cambrian history of the Grand Canyon region. Pt. I: Stratigraphy and ecology of the Grand Canyon Cambrian. Edwin D. McKee; Pt. II: Cambrian fossils of the Grand Canyon. Charles E. Resser. Washington, D. C.: Carnegie Institution of Washington. 1945. Publication 563. Pp. viii + 232. (Illustrated.) $2.50 (paper); $3.00 (cloth).

Grand Canyon, with its over 100 miles of continuous outcrops, is an ideal region for the tracing of sedimentary rock types (facies) and time planes and the demonstration of their relationships.

Four major groups of facies make up the Cambrian section, each comprising a formation, the Tapeats Sandstone, Bright Angel Shale, Muav Limestone, and unnamed upper dolomites. The three lower formations record one major marine transgression from the west across northern Arizona. Each formation represents one dominant facies and several lesser, related ones, and is defined without regard to time planes. Formational boundaries are arbitrary and follow the contacts of interfingering tongues which express the actual relationship between the units. Oscillations of the shore produced two minor groups of facies (one transgressive, the other regressive) which show a definite sequence from the shore seaward. The sediments of each facies are pictured as built up to a considerable thickness in a staggered arrangement as the facies shifted back and forth.

Time planes are established by key beds (three fossil horizons and many beds of distinctive lithology) which are traced along the outcrop. A few extend across the region, others for from 30 to 80 miles. Altogether they form an overlapping series of planes which, superimposed on the lithologic pattern, show the time relations.

Fifteen facies are analyzed. Only the conglomerate facies represents beach or near-shore conditions, and the Tapeats coarse-grained sandstone is considered an offshore deposit (1 to 20 miles, in water depths of 20 to 60 feet). Transgressive facies are, in sequence from sea shoreward, the Muav mottled limestone (its shoreward margin 150 miles from the strand), a *Girvanella* limestone, and a tongue of rusty-brown dolomite passing into shale. This thin, but extensive, dolomite is considered an original facies precipitated in an area of slight deposition. Regressive facies are, from the shore-side seaward, shales, occasionally flat-pebble conglomerate, platy siltstones, and thin silty limestones. McKee argues for the deposition of flat-pebble conglomerate well below sea level and many miles distant from shore, but does not make clear the site of origin of the pebbles. Glauconite, abundant in both groups of facies, is considered indicative of many significant diastems.

Seven members of the Muav, and one member and seven dolomite tongues in the Bright Angel, are named. The members are rock units representing age subdivisions, and their boundaries are determined by the lithologic key beds. The steady eastward (shoreward) thinning of these rock units indicates that the slow, uninterrupted accumulation of limestone more than balanced the permanent sedimentation of detrital material because of frequent breaks of nondeposition or scour in the east.

The Cambrian sea encroached upon an Ep-Algonkian erosion surface which, in the west, was on granites and had a relief under 100 feet, but in the east, had faulted Algonkian ridges forming 800 foothills. The major transgression consisted of periods of rapid sinking of the basin and eastward spread of the transgressive facies, followed by cessation of sinking, filling of the basin, and westward spread of the regressive facies. The single member of the Muav in easternmost Grand Canyon marks the turning point of sedimentation. The uppermost Muav member indicates that the major Cambrian regression had started, but no further westward shift of facies is apparent as the section passes vertically into dolomites. The latter are interpreted as regressive marine deposits in a filled basin covered by very shallow, concentrated water.

In Part II all known fossils are reviewed and described. One cystoid, 1 gastropod, 14 brachiopods, and 36 trilobites merit specific description, and a number more are placed generically. The paucity and poor preservation of the material is amazing, and more intensive collecting should be done. An *Olenellus* and *Antagmus* horizon date the lower beds as late Lower Cambrian. Horizons of *Alokistocare althea* and *Glossopleura mckeei* and of *Solenopleurella porcata* date most of the Bright Angel and the Muav as early Middle Cambrian. The collections are too small to indicate distinct faunal zones or satisfactory zonal correlations.

CHRISTINA LOCHMAN

Mt. Holyoke College

Physical chemistry of cells and tissues. **Rudolf Höber and collaborators. Philadelphia: Blakiston, 1945. Pp. 675. (Illustrated.) $9.00.**

This is the book which we had long been expecting as the American analogue of Dr. Höber's *Physikalische Chemie der Zelle und der Gewebe.* That went through six editions, and the last, in 1926, is encyclopedic and a classic for the cell physiologist. It probably would have been asking too much of the author to have maintained the same scheme of the original edition. Perhaps this may still be done.

The present book follows the current vogue of multiple authorship, the author having enlisted the services of four collaborators. David I. Hitchcock, of Yale, and J. B. Bateman, of the Mayo Clinic, are responsible for the first two sections, which are strictly on physical chemistry. The section by Hitchcock deals with selected principles of particular import for our knowledge of living matter, viz., diffusion in liquids, reaction velocity and enzyme action, thermodynamics, the energy concept, electromotive force, and properties of aqueous solutions. This section of 91 pages and 126 references is clear and concise, depending freely on the references for essential details—an admirable method of presenting fundamentals with lessened risk of becoming lost in too deep a forest of details.

The second section, by Bateman, is on the physicochemical properties of large molecules, with a discussion of their architectural and functional significance in living matter. This extremely valuable section of 121 pages with 534 references includes a discussion of fibers, films, and membranes so widespread as structural forms of living matter.

The sixth section, by David R. Goddard, of the University of Rochester, is an excellent discussion on the respiration of cells and tissues (74 pages and 199 references). The discussion is devoted to the mechanism of cellular respiration, the development of which has been so largely during the last two decades. Dr. Goddard deals with the energetics and kinetics of the process involving a series of graded steps with many distinct enzymes, the whole constituting an integrated reaction system. The writer presents a fascinating story of a general pattern of cellular respiration by emphasizing the physicochemical approach. Coupled reactions permit the storage of oxidative energy in the form of high-energy phosphate bonds which may be transferred, stored, or utilized, as needed. The mechanism of energy transfer is suggested by Engelhardt's discovery that myosin, the contractile protein of muscle may itself be the enzyme to induce the hydrolysis of adenosin triphosphate. This case of a catalyst accepting the energy liberated by its substrate would appear to be the first biochemical reaction discovered which directly converts the potential energy of a chemical compound into mechanical work.

Another well-developed section is by Wallace O. Fenn, on contractility (79 pages with 316 references). A very brief discussion of protoplasmic streaming, ameboid and ciliary movement as phenomena of contractility is followed by an excellent account of muscle contractility. Interesting experimental data are presented, and the section ends with a discussion of muscle contracture and a survey of theories of muscle contraction historically developed, ending with the significance given by the newer knowledge of the configuration of protein structure. The phosphate cycle provides the energy, and the change in configuration of the myosin from a partial to a more complete folding causes the shortening. The shortening may result from a phosphorylation of the myosin serving as an enzyme for the removal of PO_4 from adenylpyrophosphate.

The four remaining sections are by Dr. Höber and occupy somewhat less than half of the book. A brief section deals with introductory remarks on the architecture of protoplasm. He offers an interesting concept of a chemodynamic machine having a submicroscopic structure which is so spread as to form a very large area for adsorption catalysis.

The section on permeability follows somewhat the classic lines and deals with organic nonelectrolytes, weak bases and acids, dyestuffs and water. From this discussion is deduced the chemistry and physics of the plasma membrane for the structural basis of which he offers evidence. Regarding the permeability of nonelectrolytes, their passage is related to molecular volume and lipoid solubility. In an analysis of experiments dealing with pore size, consideration might have been taken of the fact that many nonelectrolytes exist as molecular aggregates varying in size according to the nature and pH of the medium. Moreover, the determining characteristics of the medium may change on approaching surfaces, such as those of cells. The chapters on permeability attest to the great variability encountered with different types of cells, a valuable feature to be pointed out in the face of those who may attempt too sweeping generalizations. Dr. Höber is to be commended for the carefulness of his survey. The only question which arises is whether the subject may have been more easily handled if, instead of grouping various cell types under headings of permeability to different substances, the different types of cells had been taken up separately with respect to their permeability to various substances.

In the section dealing with extracellular factors on cellular activity, the author discusses the influence of inorganic ions on hydration and dehydration of cell colloids, on fiber and cell potentials. This leads into selective ion-permeability and bioelectric membrane potentials. One chapter discusses the influence of ions on cell potentials in plants, and is an excellent summary of the work of Brooks' and Osterhout's groups. The chapter on narcotics again brings up the concept of the plasma membrane as lipoid in nature with a sieve structure.

The last section deals with a favorite field of the author's extensive research activities. Here the author distinguishes between passive penetration and active transfer, the latter appearing to be "enforced" by energy ordinarily derived from cell metabolism and indispensable for the process. Good chapters follow on intestinal absorption, the formation of urine, and the elaboration of digestive juices. Passive and active transfer are also discussed in relation to the body surface of aquatic animals and of plant cells. The last chapter is an excellent discussion of the energetics of active transfer and possible mechanisms in the localization of enzymes constituting a chemical organization comparable to the morphological organization of cell structure.

In many places the author gives free play to his imaginative genius and makes us wish he had greatly expanded his part of the book for us to profit more by the broad background of his knowledge and the wealth of his own contributions. This is a book which should be in the hands of all students of fundamental problems in physiology. One would wish that, for books such as this, funds were available to subsidize their publication so as to bring the price within the range of the usual scientific worker.

ROBERT CHAMBERS

New York University

Scientific Book Register

ADRIANI, JOHN. *The chemistry of anesthesia.* Springfield, Ill.: C. C. Thomas, 1946. Pp. 536. (Illustrated.) $7.00.

ARCHER, W. ANDREW. *Collecting data and specimens for study of economic plants.* (U. S. Dept. of Agric., Misc. Publ. No. 568.) Washington, D. C.: Government Printing Office, 1945. Pp. 52. (Illustrated.)

BELLINGHAM, ELLEN F., *et al. Bibliography of industrial hygiene, 1900–1943: a selected list.* (U. S. Publ. Hlth Serv., Publ. Hlth Bull. No. 289.) Washington, D. C.: Government Printing Office, 1945. Pp. 106. $.20.

CHURCH, PHIL. E. *The annual temperature cycle of Lake Michigan. 2: Spring warming and summer stationary periods, 1942.* (Dept. of Meteorol., Misc. Rep. No. 18.) Chicago: Univ. Chicago Press, 1945. Pp. 100. (Illustrated.) $1.50.

DICKE, F. F., and JENKINS, MERLE T. *Susceptibility of certain strains of field corn in hybrid combinations to damage by corn earworms.* (U. S. Dept. of Agric., Tech. Bull. No. 898.) Washington, D. C.: Government Printing Office, 1945. Pp. 36. (Illustrated.) $.10.

DOEBEL, SISTER MARY OF GRACE. *The preparation of certain isomeric heptanes.* Washington, D. C.: Catholic Univ. America, 1945. Pp. 43. $1.00.

DUBOIS, JOHN HARRY, and PRIBBLE, W. I. *Plastics mold engineering: the fundamentals of plastics mold design and construction.* Chicago: American Technical Society. Pp. 503. (Illustrated.) $7.00.

GARDNER, ROBERT. *Some soil properties related to the sodium salt problem in irrigated soils.* (U. S. Dept. of Agric., Tech. Bull. No. 902.) Washington, D. C.: Government Printing Office, 1945. Pp. 28.

HARRIMAN, PHILIP LAWRENCE. (Ed.) *Twentieth century psychology: recent developments in psychology.* New York: Philosophical Library, 1946. Pp. xiii + 712. (Illustrated.) $6.00.

KIVER, MILTON S. *Television simplified.* New York: Van Nostrand, 1946. Pp. 382. (Illustrated.) $4.75.

KUDO, RICHARD R. *Protozoology.* (3rd ed.) Springfield, Ill.: C. C. Thomas, 1946. Pp. 778. (Illustrated.) $8.00.

LANTZ, BEATRICE. *Some dynamic aspects of success and failure.* (Psychol. Monogr., Vol. 59, No. 1, Whole No. 271.) Evanston, Ill.: American Psychological Association, 1945. Pp. 45. (Illustrated.)

LESPAGNOL, ALBERT. *Pharmacie chimique avec les preparations industrielles des medicaments.* (2nd ed.) Paris: Vigot Frères. Pp. 911.

MARKUS, JOHN, and ZELUFF, VIN. (Eds.) *Electronics for engineers.* New York: McGraw-Hill, 1945. Pp. 400. (Illustrated.) $6.00.

MAURER, EDWARD ROSE, *et al. Mechanics for engineers; statistics and dynamics.* New York: Wiley, 1945. Pp. 442. (Illustrated.) $4.00.

MILLER, CAREY D., and BAZORE, KATHERINE. *Fruits of Hawaii; description, nutritive value, and use.* (Rev. ed. of *Some fruits of Hawaii.*) (Univ. Hawaii Agric. Exp. Sta. Bull. 96.) Honolulu: Univ. Hawaii, 1945. Pp. 129. (Illustrated.) $1.00.

SCHMEDEL, JOHN B. *Clinical roentgenology of the heart.* (Annals of roentgenology ser., 18.) New York: Harper, 1946. Pp. 391. $12.00.

SLADE, SAMUEL, and MARGOLIS, LOUIS. *Mathematics for technical and vocational schools.* (3rd ed.) New York: Wiley, 1946. Pp. 539. $2.50.

————. *Report on the progress and condition of the United States National Museum for the year ended June 30, 1944.* Washington, D. C.: Government Printing Office, 1945. Pp. iii + 100. $.35.

————. *Wiley trigonometric tables.* (2nd ed.) New York: Wiley, 1945. Pp. 122. $1.00.

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Technical notes on Neoprene. The Organic Chemicals Department of Du Pont recently wrote to ask if we would want to see regularly their *Neoprene notebook.* We do, and so may you. This publication is issued four to six times a year. It contains new technical information about this versatile synthetic rubber based on research in the Du Pont laboratories. The issue we received had short articles on sunlight aging performance of Neoprene compositions, the use of pump or gland packings made of Neoprene, and a page of questions and answers on the properties of the various formulas of Neoprene which the company makes. For your copy ask for *Neoprene notebook SC–464.* Organic and Rubber Chemicals Department, E. I. du Pont de Nemours and Company, Wilmington 98, Del.

Industrial and radio laboratory equipment. Readers of *Science* who do research in radio and physics either academically or on a consultation basis will be interested in two items just received from the General Radio Company of Cambridge, Mass. This company publishes a bimonthly publication under the title *The general radio experimenter.* It is attractively printed with charts, graphs, and suitable cuts and punched for filing in a handy notebook. The January–February issue, which has just arrived, contains an article on "The series and parallel components of impedance" and another on "Heat dissipation from cabinets." Scientists who are also sportsmen (particularly fishermen) will enjoy "An engineering approach to trout fishing," which describes the measurements made by one of the company's engineering staff on water depth and temperature in Lake Winnepesaukee. In the same envelope we received a copy of the postwar supplement to the company's general catalogue. In it are details and specifications for a wide range of equipment such as bridges, oscillators and standard signal generators, waveform-measuring instruments, meters, frequency-measuring instruments, and amplifiers and power supplies. For copies, ask for *The general radio experimenter SC–464* and *Postwar supplement to general catalogue K.* The General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Mass.

Microscope slides. From George H. Conant of Ripon, Wis., came his catalogue of microscope slides of botanical species. The catalogue is divided into four parts: microscope slides for general botany; guide to special plant structures; supplementary slide list; and special slide sets. The whole issue is excellently illustrated with color prints of some of the slides available. Botany instructors will be interested in the section on special slide sets, which includes combinations of slides on such basic topics as algae, parasitic fungi, mosses, fern sporophores, life history of *Lilium Michiganense,* special plant structures, commercial woods, cytology, general morphology, and diseases of economic plants. Requests should specify *Catalogue No. 7, Triarch botanical supplies SC–464.* George H. Conant, Ripon, Wis.

Biological and pharmaceutical supplies. The latest catalogue of these products issued by the pharmaceutical laboratories of the National Aniline Division has been received. The table of contents indicates that the company furnishes the following products in research and/or bulk quantities: commission certified stains; biological stains; vital stains; staining solutions; indicators (both Clark and Lubs and oxidation-reduction); laboratory reagents; and certified colors for foods, drugs, and cosmetics. Prices for each product as of the date the catalogue was issued are given. *National pharmaceuticals, Price list SC–464.* Pharmaceutical Laboratories, National Aniline Division, 40 Rector Street, New York 6, N. Y.

Wratten light filters. The Eastman Kodak Company has recently released the seventeenth revised edition of its well-known handbook on this subject. This latest edition, which incorporates the most recent data from laboratory research, has sections on the care of filters, filter sets for commercial and scientific uses, neutral density filters and wedges, sensitizing classes of plates and films, filter factors, mercury spectrum, list of filters and their stabilities, spectrophotometric absorption curves of filters, pairs of filters, infrared absorption spectra, and total and wave-length transmission. *Wratten light filters* (17th ed., rev.) *SC–464.* $.50, postpaid. Eastman Kodak Company, Rochester 4, N. Y.

New and established medical books. Paul B. Hoeber, Inc., the Medical Book Department of Harper and Brothers, has mailed in a new catalogue issued in January. In addition to listing books bearing the Hoeber imprint which have become recognized authoritative references, there are descriptions of over 100 recently issued books. Typical of the new books are: *General and plastic surgery (with emphasis on war injuries), Fundamentals of pharmacology,* and *Clinical roentgenology of the heart.* We noted, too, that many of the standard references are scheduled for complete revision early this year. *1946 Hoeber catalogue SC–464.* Paul B. Hoeber, Inc., 49 East 33rd Street, New York 16, N. Y.

Toxicants for insecticides. A new comprehensive brochure on Thanite, DDT, and derivatives and combinations of both of these insecticide concentrates is now available from Hercules Powder Company. Entitled *The Thanite family,* it is a 32-page book containing considerable new information on the use of these concentrates in household sprays, livestock sprays, flea powders and dips, and in pest and pediculosis control. Among the concentrates discussed are Thanite, Thanite plus DDT concentrate, DDT, water miscible DDT concentrate, and oil-soluble DDT concentrate. *The Thanite family SC–464.* Hercules Powder Company, Wilmington, Del.

SCIENCE

Vol. 103, No. 2671 Friday, March 8, 1946

The Neutron, the Intermediate or Compound Nucleus, and the Atomic Bomb[1]

William Draper Harkins

The University of Chicago and the Universal Oil Products Company

THE ATOMIC BOMB IS A MONSTER reared by war. A fact revealed by history is that the offense grows much more rapidly in power than the defense in its ability to cope with it. Indeed, this seems to be a natural law, since warfare was formerly restricted to the surface of the earth and was, therefore, two-dimensional. Now, it is rapidly rising above those limits of the atmosphere suitable to the life of man and is expanding in the third dimension. The offense can choose any portion of space thus made available, but it is impossible for the defense to cover every location in this space. Concomitant with this conquest of space is one of time, since jet propulsion makes it possible to exceed the velocity of sound.

Now, in addition to the conversion of space into the slave of war, nuclear energy is also enslaved. The danger here is one of mass and space. A few pounds of uranium 235 or of plutonium 239 carried in small packages may be put into such a form as to destroy a whole city, being set off by a time clock. The apparatus necessary to detonate the material would be much larger.

In the opinion of the writer, grave errors in connection with the bomb have imperiled the international situation. These need not be cited, but, the benefits to mankind of the energy made available are small compared to the uncertainty thereby introduced into human life. Man has not as yet attained the state of moral and intellectual development to make it safe to have such a weapon. Therefore, (1) no more bombs should be produced; (2) any uranium 235 or plutonium 239 now available should be distributed to universities or hospitals for scientific or medical work only; (3) a world association of scientists should be formed to oppose work on the bomb; (4) the United States should use its utmost influence to establish at once a temporary world organization, to be made permanent later, to suppress the use of the bomb.

Presumably this would require some type of World Government to control war. This might be associated with the United Nations Organization.

What has been written thus far refers to the bomb. However, nothing can stop progress in the use of the energy of fission for the development of power, but this should be under the control of the World Government to prevent its degeneration into the purposes of war. On account of the injurious effects of the radiations given off, the shielding essential to protect life necessitates large installations if human beings are near by. Thus, while ships might make direct use of this power, it is not suitable for automobiles.

While no mention of thorium is made in the paper which follows, it seems not unlikely that this element will be utilized more than any other. If this is done, it is probable that one method will be to convert this into uranium. To thorium of mass 232 a neutron would be added, thus forming thorium 233, which would then change into element 91 by loss of an electron and into element 92 (uranium) by the loss of another electron. Presumably, this isotope of uranium of mass 233 would undergo fission. Since thorium is more abundant than uranium 238, there is no lack of an abundant supply. If this comes true, uranium 233 and plutonium 239 would become the sources of industrial energy. Uranium 235 is less suitable on account of the necessity of at least partially separating it from uranium 238.

---

[1] This article had its origin in an attempt to answer many questions which arose after the first use of the atomic bomb and the publication of the Official Report written by H. D. Smyth. The only direct connection of the writer with this work was the building of the Chicago cyclotron, which was used in the Metallurgical Project at the university. An attempt has been made, without too much success, to avoid as much as possible topics discussed in the Official Report. Obviously, however, many of the topics considered there must be discussed here, if what is presented is made at all intelligible. For fifteen years, from 1913 to 1928, the writer and his collaborators were the only ones in America engaged in work on the structure of the nucleus of the atom. This involved the earliest use of the Wilson Cloud Chamber for the photography of what is commonly called nuclear disintegration. This work gave rise to an idea which may be expressed as follows: In what had been earlier considered as a direct disintegration of the atom the actual primary process is not the disintegration but the synthesis of an activated nucleus which disintegrates later, although after an extremely short life. It is the relations of this idea which are discussed in this article.

I. Introduction: Disintegrative Synthesis of Atomic Nuclei

There are certain relations discovered long ago and discussed here which are involved in the action of what has been designated as the *atomic* bomb, or, more properly, the nuclear bomb. Some of these may make it more simple to understand what occurs in the release of the extremely great amount of energy, as compared with the mass involved, when the bomb explodes.

The nucleus of the atom is an extremely minute body which may consist of only one particle, or of as many as 239 particles, very tightly bound together by nuclear forces. These primary particles are designated as the proton (nucleus of the hydrogen atom), with a mass of 1.00758 and unit positive charge of electricity, and the neutron, of mass 1.00893 without an electrical charge. The diameter of a single proton or neutron in any nucleus is about 3×10^{-13} cm.

Developments based upon the discovery of radioactivity by Becquerel in 1896 and the later discovery and separation of radium by Mme. Curie showed that the heaviest or radioactive atoms may disintegrate naturally to give off either negative electrons, which may even approach the velocity of light, or alpha particles, proved by Rutherford and Royds in 1909 to give gaseous helium when they are collected. Later it was shown that an alpha particle, which has a positive charge of 2, due to the two protons which it contains, is actually the nucleus of the helium atom. Each alpha particle contains two protons which would repel each other if they were not bound together by two neutrons. These alpha particles may have velocities as high as, or even higher than, 12,000 miles per second.

In 1919 Rutherford in a very remarkable and extremely simple experiment showed that he was able to obtain the disintegration of one of the lightest atoms, which he assumed to be that of nitrogen. This led to the idea that atomic nuclei may be disintegrated artificially, since the nuclei of the nitrogen atom which he used seemed to be split into two particles, one a carbon nucleus and the other a proton, by a mere, though excessively energetic, blow of a fast alpha particle.

Soon after this the writer came to the conclusion that the simplest method which could be used to determine whether or not a nucleus of the nitrogen atom is split in this way would be to use the Cloud Chamber of C. T. R. Wilson, a most remarkable apparatus which makes it possible to photograph the tracks of atoms as described later. From photographs obtained in this way the writer came to the conclusion that the primary action is not a disintegration but a synthesis of new nucleus, in the formation of which the nucleus used as a projectile is always captured by that used as a target (Fig. 1). The compound nucleus thus formed disintegrates later, after an *extremely* short life. Nevertheless, the life period is sufficient to make the disintegration of this nucleus, which is always in an excited state, an event entirely independent of its synthesis, since enough time elapses to distribute the energy introduced with the projectile through the whole nuclear system. Thus, the disintegration of this nucleus does not depend upon what nuclei have joined together to form it, *but only upon the state in which the excited nucleus exists.*

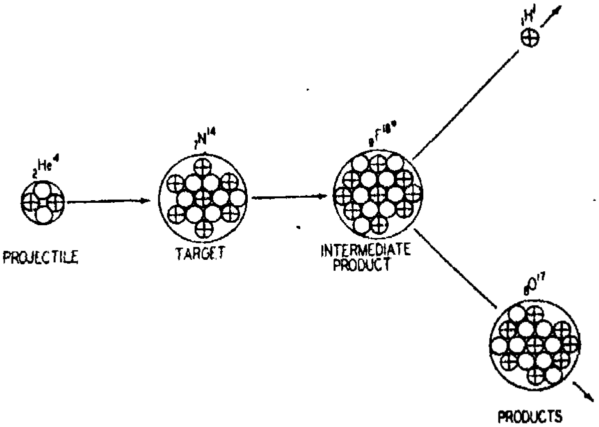


Fig. 1. Formation of oxygen 17 and hydrogen 1 by the disintegration of fluorine 18, the intermediate nucleus formed by the impact of helium 4 with nitrogen 14. Open circles = neutrons. Circles with plus signs = protons. At higher energies the excited fluorine nucleus disintegrates in two ways: (1) that given in the diagram, and (2) to give a neutron and positive electron in place of a proton (= hydrogen 1).

This greatly simplifies the consideration of nuclear transformations, since, as illustrated later, the same composition of the compound nucleus and essentially the same activated state may be obtained by the use of different projectiles. For example, carbon 12 (C^{12}) can be formed by the impact of hydrogen 1 (H^1) upon boron 11 (B^{11}), or of hydrogen 2 (H^2) upon boron 10 (B^{10}), but the excited carbon nucleus thus formed gives, in either case, as the final result of its disintegration, three alpha particles, *i.e.* three helium atoms. Thus, it is not the disintegration which is artificial, since this is entirely spontaneous, but it is the synthesis of the compound nucleus which may be brought about by artificial means.

While the writer's theory of the occurrence of nuclear reactions by the formation of an intermediate excited nucleus was accepted by a very few experimental physicists, it met with very strong opposition on the part of nuclear theorists during the years 1926–36, the period in which experimental evidence in favor of these ideas was being collected. This opposition was due to the fact that, whereas the nucleus consists of an aggregation of protons and neutrons bound together by an extremely strong interaction, giving a density so great that it is incomprehensible to ordinary human beings, theoretical physicists of the period treated it upon the basis of the Hartree formula, which in itself assumes a loosely bound aggregation (the free particle model of the nucleus). For example, Bethe (*1*), who favored the idea that the interaction between the particles in a nucleus is small, in a private conference in June 1936, stated that the existence of the intermediate nucleus, as demanded by the theory of the writer, is impossible. Reviews by other theoretical physicists in 1934 stated that the law of conservation of energy would have to fall before such an intermediate nucleus could exist. These ideas were based upon the fact that at that time nuclear physicists assumed the existence of a very much smaller number of nuclear energy levels than were considered by the writer to be present.

Evidence in favor of the theory of the writer is considered in more detail later, but here it may be mentioned that the reactions which occur in the atomic bomb proceed according to the theory. Thus, either uranium 235 or plutonium 239 is an entirely innocuous material, since the atoms of these substances are quite stable, having the type of stability found in radioactive atoms of moderately long life. It is not these which disintegrate by fission to give the excessively high energy of the bomb, but in each case it is the intermediate, or compound, nucleus uranium 236 or plutonium 240, which disintegrates by fission to give the energy. These relations are considered in more detail in a later section.

II. ENERGY OF THE BOMB

The effectiveness of the bomb is due to the fact that it develops an amount of energy which is enormous in comparison with the mass involved, in an exceedingly short space of time (of the order of a millionth of a second). This development of energy is accomplished by bringing about a nuclear reaction. A chemical reaction, such as the burning of coal or the explosion of an unstable compound, known as an explosive, may develop a large amount of energy. In general, a nuclear reaction which involves the same amount of mass develops from one to ten million times as much.

In 1897 Kaufman found that particles (in his experiments, negative electrons) have a higher mass when their velocity is high than when they are at rest. Eight years later Einstein developed a remarkably simple equation which the writer likes to consider from the following point of view. We may write an equation in which E represents energy in any form and m, mass in any form, as follows:

$$E = m$$

This equation may be said to be valid if both E and m are given in ergs, or both in grams, but in the use of this equation E cannot be expressed in ergs and m in grams. However, this can be done if the equation is written:

$$E = mc^2$$

which is Einstein's equation. The remarkable achievement of Einstein was that he showed that the transformation in units and dimensions involves a natural constant,

$$c^2 = (3 \times 10^{10})^2$$

which is the square of the velocity of light.

Others may prefer to write the equation as

$$-\Delta m \cdot c^2 = \Delta E.$$

This indicates that a decrease of mass of Δm grams involves an increase in energy of ΔE ergs. That the energy developed in a nuclear reaction may be excessively large was shown in 1915 by Harkins and Wilson (*4*), who had been engaged in a consideration of the heat of the sun and stars. They found by the use of Einstein's equation that if 4 hydrogen atoms are by any series of processes converted into one atom of helium the energy liberated between the initial and final states is extremely large. Thus, a single pound of hydrogen by this "nuclear combustion" gives as much heat as the burning of *ten thousand tons,* or ten million pounds of coal. Here, the nuclear reaction gives ten million times the energy of the chemical reaction. Although later certain noted physicists considered that the reaction in which helium is formed occurs almost instantaneously, it was obvious that four exceedingly small protons could not meet and, in addition, lose two positive charges (the proton has a positive charge of one, and the helium nucleus or α-particle a positive charge of two) in a sufficiently minute time to give such a synthesis. Thus, the reaction must of necessity occur in steps, but a consideration of these steps is not involved in the calculation of the energy.

The mass of the hydrogen atom nucleus (proton) is 1.00758 and of the helium atom 4.0039. The mass of the helium nucleus is $4.0039 - 2 \times (0.000549$ mass of electron$) = 4.0028$. Now, four protons have a mass of $4 \times 1.00758 = 4.0303$, so $4.0303 - 4.0028 = 0.0275$ is the loss of mass. Consider these masses in grams; then the decrease of mass is -0.0275 g and $E = 0.0275 \times 9 \times 10^{20} = 2.475 \times 10^{19}$ ergs for the formation of 4.0039 g of helium from 4.0325 g of hydrogen (these masses now include the masses of the electrons outside the nucleus). This is 6.138×10^{18} ergs per gram = 1.467×10^{11} calories per gram = 6.654×10^{13} calories per pound, or 25.6 million electron volts.

The calculation of the energy developed in the fission of uranium 236 or of plutonium 240 would be just as simple as that for the energy of synthesis of helium given above, if the masses of all the final products of the fission were known. The problem is discussed later, but the energy given by one pound of the uranium isotope is equivalent to that produced in the burning of (about) 1,300 tons of coal (about 200 million electron volts). Thus, the *disintegration* of this heavy nucleus gives less than one-sixth as much energy per unit mass as the synthesis of helium.

In 1893 and later, Landolt, in a classical experiment which involved a long series of very accurate weighings, endeavored to determine the loss of mass in a chemical reaction which evolves heat. In connection with the calculations of nuclear energy changes, Harkins and Wilson found, by the use of Einstein's equation, that in the formation of 18 grams of water from hydrogen and oxygen the energy evolved is equivalent to only 3 *billionths of a gram,* which explains Landolt's failure to detect the loss of mass.

III. ELECTRIC CHARGE, THE PRINCIPLE OF ELECTRICAL NEUTRALITY AND ATOMS

One of the most fundamental laws of nature is that the electric charge of any "primary" particle may have a positive or negative sign, but the magnitude of the unit electric charge is invariable, *i.e.* the same (1.60 coulombs) for any single particle.

Furthermore, in any material body that we know, the number of negative charges is extremely closely equal to the number of positive charges. The departure of the earth as a whole from this principle of electrical neutrality is excessively small. Only extremely small bodies exhibit any considerable percentage variation from this principle. By definition any *atom* is electrically neutral: if it contains more negative than positive charges, it is designated as a negative ion, or with more positive than negative, a positive ion.

The nucleus of the atom, when it is free, as it may be at exceptionally high velocities, exhibits the greatest departure from electrical neutrality, since, according to our present philosophy, every charged particle which it contains is positive, *i.e.* a proton. A nucleus which is relatively "stable" may contain from one proton (hydrogen atom) to 92 protons (uranium atom) or even 94, since plutonium is moderately stable. The electrically neutral atom must then contain as many negatively charged particles (electrons) as the *number* of protons in the nucleus. This number (Z) is designated as the *atomic number,* though actually it is the *element number* in the periodic table of Mendelejeff.

The electron, or electrons, may be considered to move around the nucleus, where they form a cloud which is excessively tenuous, when considered in comparison with the high density of the nucleus. The mass of the proton is 1.672×10^{-24} grams. If this is contained in the 1.4×10^{-38} cc. considered as its volume, the density is 1.2×10^{14} grams or 130 million tons per cc. Thus, the whole earth would have a diameter of only 460 meters, or less than a third of a mile (0.286 miles) if its *whole mass* were present as protons and neutrons packed as they are in the nucleus of an atom. The presence of electrons, however, reduces the density from 1.2×10^{14} g per cc. to that of the earth (5.522 g per cc.) which is 20 million million times smaller.[2]

IV. ELEMENTS AND ISOTOPES

According to Section III, the number of electrons in an atom is equal to the number of protons in its nucleus. It was shown by Mendelejeff in 1868 that the chemical properties of the elements may be expressed as a periodic function of the atomic weight. In 1896, Rydberg and, later, van der Broek and, by direct experimental evidence, Moseley indicated that the relationship becomes more exact if the atomic number is considered instead of the atomic weight. According to more recent theory, the atomic number gives the positive charge on the nucleus, which is equal to the number of protons which it contains.

The atomic numbers of the elements thus far found in nature vary from 1 to 94 so it is often said that there are 94 elements. Of these, however, the nuclei with 61, 85, and 87 protons have not as yet been discovered in any known material. However, they have been produced by artificial means. It should be considered that there is also another element of zero atomic number which consists of neutrons. These carry no charge and thus its atoms contain no electrons and have no ordinary chemical properties. Elements 93 and 94, neptunium and plutonium, have now been produced artificially, and obviously it is possible with sufficient amounts of plutonium to push the artificially produced elements to still higher atomic numbers. When the chemistry and the spectrum of any of these becomes well determined, it is possible that some of them may be found to exist in nature.

Until the year 1907 it was considered that each known element is actually elementary, but in this year

---

[2] The size of the nucleus is obtained by calculations made on the basis of the scattering produced in elastic collisions between nuclei and exhibits some variation with the velocities of the particles at the time of the collision.

McCoy and Ross, of the Department of Chemistry of the University of Chicago, made the remarkable discovery that there exist in thorium at least two varieties of this element. These have highly different stabilities, but the same chemical properties, and are now known as isotopes (*5*). The announcement of this discovery was made in the following simple statement: "In fact, it now appears doubtful whether it is possible by chemical treatment to separate any radiothorium from thorium." Both of these atomic species have the atomic number 90 and therefore belong to the same chemical element, although the atomic weights are 232 for thorium and 228 for radiothorium. It is now known that the element thorium consists of 6 isotopes. The known elements consist of from 1 to 10 isotopes, and the formation of these gives the existence of about 300 types of atoms (atomic species) in addition to the radioactive species of high atomic mass.

V. SEPARATION OF ISOTOPES

The separation of the isotopes of uranium of atomic masses 235 and 238 has been one of the most important problems in the production of the atom bomb. For some time after the discovery of isotopes it was considered that isotopes were inseparable. However, in 1919, Harkins and Broecker made the first separation of isotopes which was proved to be obtained. They obtained a partial separation of chlorine of atomic weight 35.46 into two isotopes of weights 35 and 37. A similar separation had been made in 1916 and early in 1917 by Harkins and Turner, but the war made it impossible to determine the atomic weights at that time.

The earliest detection (and determination of the mass) of isotopes by electrical means was entirely accidental. In 1913, J. J. Thomson, by deflection experiments on canal (positive) rays, found that there seemed to be two kinds, instead of one, of neon in a tube which contained this element. Although this is correct, the experiment did not appear to be entirely conclusive to Thomson or his co-workers, as indicated by a letter from the Cavendish Laboratory in 1919. In this year, Aston began an extensive series of determinations of the masses of isotopes in an improved apparatus commonly known as a mass spectrograph, and in a very long series of experiments determined the masses of a very large number of atomic species.

In the experiments of Harkins large quantities of dry hydrogen chloride gas were passed through a long series of porous porcelain tubes (churchwarden pipe stems obtained in Scotland). The ideal diffusion membrane is very thin, to reduce the time in passing through it, and has very fine pores. Later, Harkins and Mulliken found that sheets of filter paper are more efficient than the pipe stems, but the paper membrane could not have been used with hydrogen chloride.

The theory of the separation of gases by diffusion was given in 1896 by Lord Rayleigh and much more completely in 1922 by Mulliken and Harkins. The diffusion method has been used in the separation of the isotopes of uranium. Uranium, a metal which consists of 0.006 per cent 234, 0.7 per cent 235, and 99.3 per cent 238, was separated by the diffusion of its hexafluoride, which is a gas.. Unfortunately, the change to the fluoride increases the molecular weights to 348, 349, and 352, but only the two latter need to be considered. Since the lighter molecules move faster than the heavier, more of the former pass through a porous barrier. The relationship for equal kinetic energies ($\frac{1}{2}$ m v^2) of the molecules is:

$$\tfrac{1}{2} m_1 v_1^2 = \tfrac{1}{2} m_2 v_2^2$$

or

$$\frac{v_1^2}{v_2^2} = \frac{m_2}{m_1}$$

so

$$\frac{v_1}{v_2} = \sqrt{\frac{m_2}{m_1}} = \beta$$

which is the enrichment factor, so, for uranium hexafluoride

$$\beta = \sqrt{352/349} = 1.0043.$$

Thus, if a very small amount of the uranium compound passes through a very fine porous wall, it contains, after the diffusion, under ideal conditions, 1.0043 times more uranium 235 than before, or 0.70301 per cent, if the initial percentage is 0.7. It is obvious that the separation is initially made much more difficult by the small percentage of uranium 235 present. The theory of the *increase* in the mean molecular weight (Δ M) of the heavy fraction is simpler, and is expressed by

$$\Delta M \,\alpha\, \frac{(M_1 - M_2)^2 x_1 x_2}{M}$$

Here, $A = (M_1 - M_2)^2 = 3^2 = 9$, which is a somewhat favorable factor for the separation of isotopes. However, M, the mean molecular weight, is about $352 = B$, which is very unfavorable, and $x_1 x_2$, the product of the fractions present, $0.007 \times 0.993 = 0.007 = C$, is also extremely unfavorable. Thus, the molecules must pass through a very large number of porous barriers to obtain any considerable separation. When hydrogen chloride is diffused, $A = 2^2 = 4$, $B = 36.46$, and $C = 0.23 \times 0.77 = 0.177$. Here, for hydrogen chloride, only A is less favorable, while B and C are very much more favorable than with uranium as its hexafluoride.

When the percentage of uranium 235 in the light fraction becomes sufficiently high, the magnetic separation becomes more efficient than diffusion. The electromagnetic method is discussed somewhat fully in the official report and need not be considered here.

VI. THE NEUTRON

The neutron was discovered in 1932 by Chadwick. This discovery illustrates the advantage of having an idea that a particle exists before attempting to discover it. That a neutron exists was assumed by both Rutherford and Harkins independently early in 1920. This atom was assumed to have a zero charge and therefore an atomic number of zero. Its mass was assumed to be unity or, more definitely, close to that of the hydrogen atom. It was predicted that on account of its zero charge it would pass with practically no resistance through the outer part of atoms, but that it could collide with an atomic nucleus or be captured by it. A bullet may be shot from the muzzle of a rifle at a relatively small velocity, yet it may travel through air for one or two miles. The bullet can go this far, because it pushes the air away from it in its flight and does not pass through the atoms in the air. An alpha particle (a helium nucleus) may have an initial velocity as high as 12,000 miles a second. It might therefore be supposed that this particle would travel in air many thousand times farther than a rifle bullet. However, its entire range is only a few inches. This is because the alpha particle does not push the atom in the air aside, but its velocity is so great that there is no time for this to occur. Therefore, it has to go directly through the cloud of electrons in the outer part of each atom which it traverses. On account of the fact that it carries with it a positive charge of 2 or of 1 (after it has picked up a single electron) it attracts these electrons and pulls many of them out of the atoms to which they belong. This takes energy and uses up the kinetic energy of the alpha particle very rapidly. An atom or molecule from which one or more electrons has been taken is a positive ion, and one to which electrons have been added is a negative ion. Thus, the alpha particle in its passage through air leaves a narrow line of positive and negative ions, and this line may be considered as the track of the alpha particle. A fast proton gives a similar track which does not contain so many ions, since the proton has a charge of 1, which is less than that of the alpha particle. Other atoms of the higher charge leave more dense tracks. Any of these may be made visible if the moist air or other gas through which they have passed is cooled by a sudden expansion and is simultaneously illuminated by a brilliant light. This procedure is usually carried out in a cylindrical chamber, which is a part of the Cloud Track apparatus of C. T. R. Wilson.

FIG. 2. First neutron found in America. Disintegration of nitrogen 15, the intermediate nucleus formed from nitrogen 14, by the impact of a neutron.

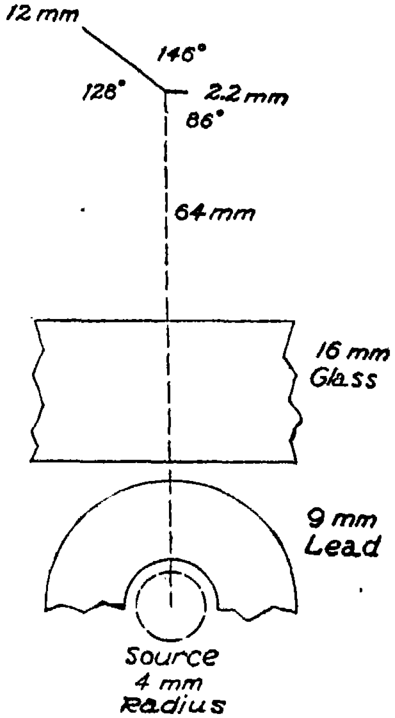


FIG. 3. Diagram of the nuclear transformation shown in Fig. 2. The neutron came from the action of a helium nucleus on beryllium in the source 4.4 mm. in radius. This passed through 9 mm. of lead, 16 mm. of glass, and, after a total range through solids and nitrogen gas of 64 mm., struck and united with a nitrogen nucleus of mass 14. The intermediate nucleus of mass 15 very quickly disintegrated into a helium nucleus of 12-mm. range and a boron 11 nucleus of 2.2-mm. range. The passage of the neutron through 9 mm. of lead and 18 mm. of glass, including the wall of the glass tube, illustrates the penetrating ability of a neutron.

Neutrons were obtained in 1930 by Bothe and Becker, when either beryllium or lithium was bombarded by alpha particles, and by Irene Curie and Joliot in 1932. Since neither of these pairs of investigators seemed to be aware that neutrons might exist, they assumed that very powerful gamma rays were involved and thus failed to discover their existence. Chadwick, however, believed uncharged heavy particles were involved and this was confirmed in 1932 by Feather, who used the Wilson Cloud Track apparatus. This was followed immediately by an even more extensive investigation by Harkins, Gans, and Newson (later also Kamen), who obtained results similar to those of Feather. Since the neutrons given off, for example, when beryllium is bombarded, do not ionize the gas through which they pass, the track is not visible in the Wilson Chamber. How, then, can the neutrons be observed? This is accomplished by means of the tracks of other nuclei which are produced by (1) elastic collections of the neutron with the nucleus; (2) inelastic collections in which the neutron is captured by the nucleus which it strikes. If, for example, this happens to be a nitrogen nucleus, a short track of a boron nucleus and a much longer track of a helium nucleus (alpha particle) are observed to originate at a single point.

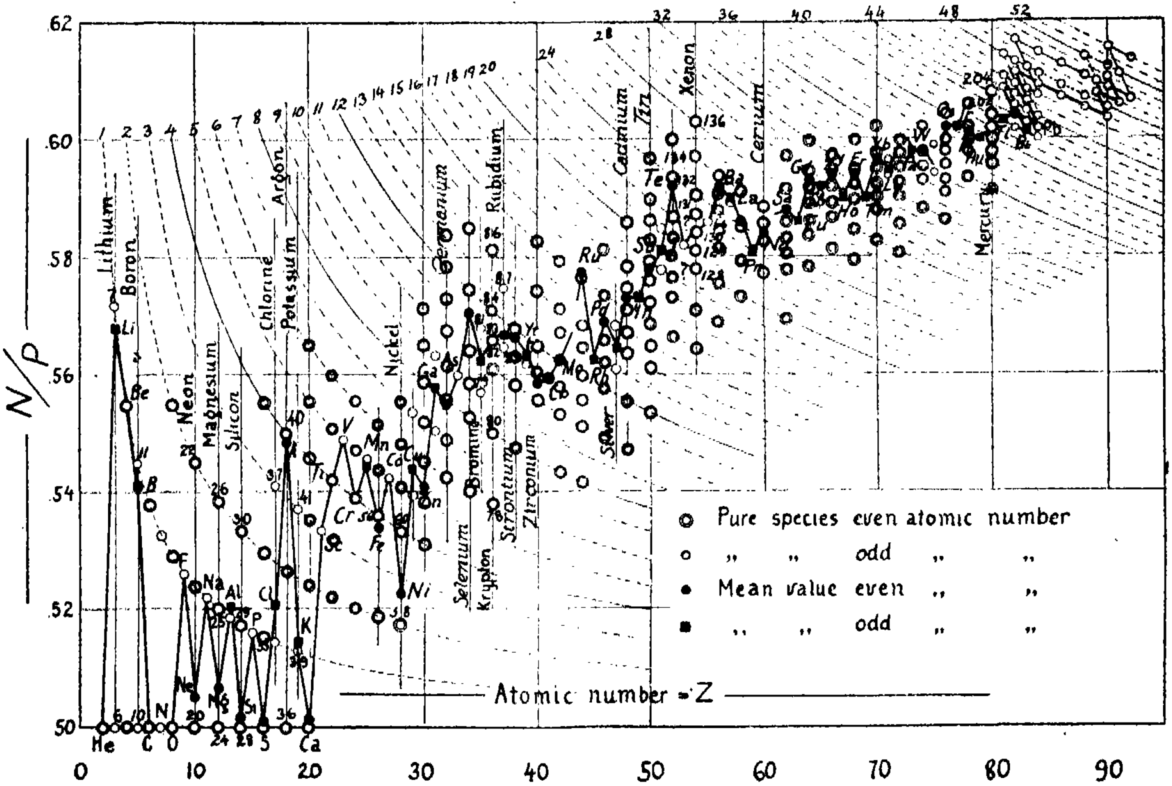


Fig. 4. Relationship between the *number of protons* Z in atomic nuclei and the *ratio of neutrons to total particles* (P = protons plus neutrons). Only stable atoms are represented. The curves, nearly rectangular hyperbolae, are numbered to give the isotopic number of the species of atoms represented. The isotopic number gives the number of neutrons in the nucleus in excess of the number of protons. *Nearly all the atoms in the earth or the meteorites are represented by the short straight line at the bottom of the figure.* In these nuclei the number of neutrons is equal to the number of protons. The positions representing the atomic species indicate in a general way the band of stability. To indicate this properly a 3-dimensional plot is essential.

From the relations found in these and other photographs of atomic transformations the writer developed the theory of the existence of an intermediate, or compound, nucleus as presented in the introduction, and also in a later section.

VII. THE VALLEY OF STABILITY

While protons, aside from the effect of their charge, presumably exhibit some attraction for each other at extremely small distances, this is much less than the repulsion between their charges. This is overbalanced in the nucleus by the strong interaction between protons and neutrons. If the number of protons is small (20 or less), at least one neutron per proton is required to stabilize a nucleus. These relations became apparent to the writer in 1921 (*3*), in a paper which considered the effects of the number of protons and neutrons in atom nuclei upon their stability. However, as the number of protons increases above 20, their repulsion becomes so great that the nuclei are not stable unless the number of neutrons increases more rapidly than the number of protons.

The stability of atomic nuclei may be summed up in terms of (1) a general relation between the number of protons and of neutrons in the nucleus, and (2) special relations which involve whole numbers, as outlined in the next section.

The general relation may be considered to be represented by a valley in which the atoms are stable, surrounded by slopes where they are partly or wholly unstable. If considered as a relation between protons on one axis and neutrons on the other, the valley is narrow. However, it is broad (Fig. 4) if the number of protons, Z, is plotted on the X-axis and on the Y-axis the ratio N/P, where N is the number of protons and neutrons ($P = Z + N$).

Except for those atomic species represented on the X-axis, all the other species lie on 54 curves, each of which is nearly a rectangular hyperbola. These represent *the isotopic* number (*I*) which gives the excess in the number of neutrons over the number of protons. Any nucleus is represented by the formula:

$$(pn)_Z n_I$$

It may be considered that a deep canyon occurs at $(N/P) = 0.5$, or $I = \text{zero}$ (the straight line of the X-axis), since in 84.5 per cent of all the atoms on earth and 79.0 per cent of those in the meteorites the number of neutrons is exactly equal to the number of protons. That *almost* all (99.9 per cent on earth and 98.4 per cent in the meteorites) of the atoms on the earth or in the meteorites have isotopic numbers of 4 or less is shown in Table 1.

TABLE 1

Isotopic number		Earth	Meteorites
0		84.5	79.0
1		13.0	5.3
2		0.2	1.6
3		0.007	0.0
4		2.2	12.4
	Sum	99.9	98.3

Thus, the valley is extremely deep at the lowest edge, rises to a ridge at $I = 3$, gives a deep valley at $I = 4$ and is shallow above this. Atoms in which N/P is too low for stability must increase N by the conversion of a proton into a neutron by giving off a positive electron. If, however, N/P is too high, a neutron must change into a proton by giving off a negative electron (β-particle).

VIII. Stability of Atomic Nuclei and the Abundance of the Elements

In 1913 the writer began a statistical study of the atomic weights then known. The results indicated several relations of interest. The atomic weights (actually mean values for the element) were found to be so close to whole numbers for elements 2 to 28 inclusive that several conclusions seemed inevitable, as follows:

(1) The masses of the atoms are extremely close to whole numbers, with the exception of that of hydrogen (Whole Number Rule). This was confirmed by Aston in 1919 and later.

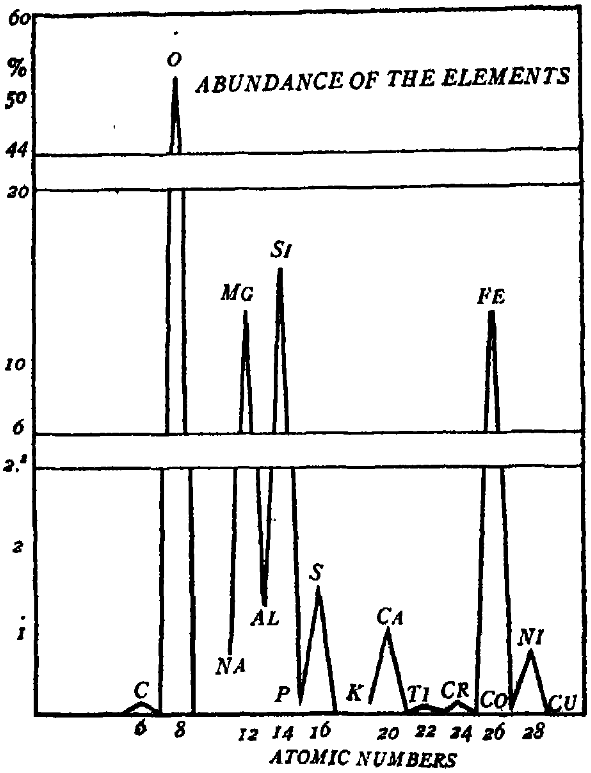


FIG. 5. Exhibits the high abundance of nuclei which contain an even number of protons. The figure gives the abundance in the meteorites. Neon (atomic number 10) and argon (atomic number 18) are gases and have escaped. In the stars, carbon, an element of even number, is extremely abundant as is also neon.

(2) Any considerable departure of the atomic weights (when correct) of the elements from a whole number was taken to indicate a mixture of isotopes. This conclusion was confirmed in the case of chlorine, atomic weight 35.46, by the separation of the element into isotopes.

(3) It was found that for elements of even atomic number above 26 (even number of protons in the nucleus) the atomic weights are no closer to whole numbers than they should be by chance. Thus, for each of these elements there should be many isotopes, while the odd elements were indicated as having only one, or very few, isotopes. Later, this also was confirmed by Aston.

The general theory of nuclear structure advanced at that time by the writer was sufficiently fruitful to give rise to several other predictions, which were verified later.

(4) Thus, the theory predicted that *elements* of even atomic number (P = even) should be much more abundant than those of odd atomic number. When this was investigated it was found that in the meteorites (Fig. 5) the elements of even atomic number are 70 times more abundant than those of odd number, while in the surface of the earth and the sun this ratio is about ten to one. Also, the stars in so far as they have been investigated seem to exhibit a decided preference for elements of even number. Thus, atomic nuclei which contain an even number of protons are much more "stable" than those in which the number is odd.

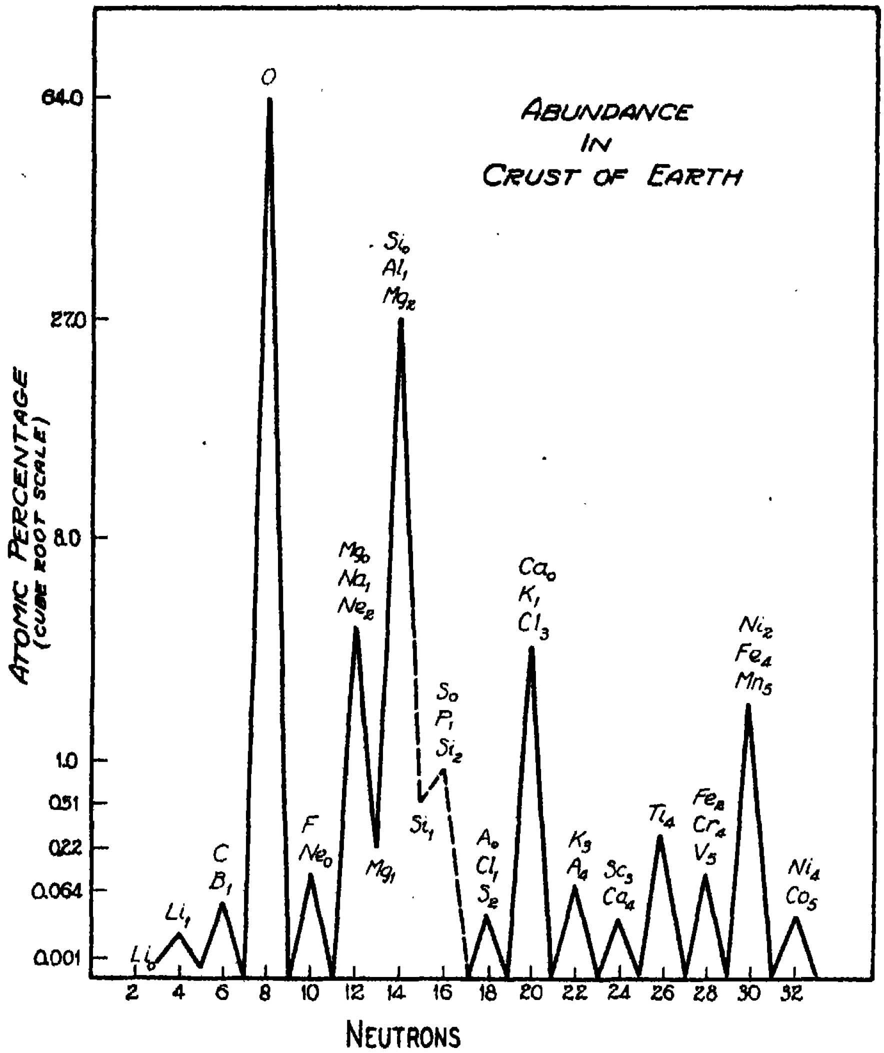


FIG. 6. Illustrates the excessively high abundance of atomic nuclei which contain an even number of neutrons, in comparison with the extremely low abundance when an odd number of neutrons is present. Note the cube root scale and that oxygen 16 (isotopic number equal zero) with the highest peak is about 100 times more abundant than the most abundant set of atomic nuclei for any single odd number of neutrons. The figures attached to the symbols of the elements are the isotopic numbers.

(5) An even more prominent relation is that in almost all "stable" nuclei the number of neutrons is even (Fig. 6). Thus, in so far as the abundance of atomic species has been determined, 99 per cent of all the atoms in the earth's crust have nuclei which contain an even number of neutrons. This relation became apparent to the writer in 1921, when he developed a formula for all nuclei as follows:

$$(\mathrm{pn})_{\hat{z}}\mathrm{n}_{\hat{\imath}}$$

in which p is a proton; n, a neutron; $\hat{z}$, the atomic number; and $\hat{\imath}$, the isotopic number. The isotopic number gives the excess in the number of neutrons above that for atoms whose nuclei contain equal numbers of protons and neutrons.

(6) Thus, there are almost no atoms whose nuclei are stable with an odd number of both neutrons and

protons: only about one atom in ten thousand on earth. This is an extremely remarkable relation.

IX. FUNDAMENTAL PARTICLES AND THE FORMATION OF PLUTONIUM

In nuclear reactions, particles other than protons and electrons, the two which are considered to exist inside the nucleus, are also involved. As stated in the last section, negative electrons (or β-particles) are given off from the nuclei of heavy (radioactive) atoms, if the particular species contains more neutrons than corresponds to stability. In such an event a neutron in the nucleus is converted into a proton by emission of an electron, or

$$n_0^1 \rightarrow p_1^1 + e_{-1}^0$$

In such a change there is only a very small loss of mass. By this type of process U_{92}^{239} (formed by the addition of a neutron to U_{92}^{238}) changes into neptunium (N_{93}^{239}). Then, by emission of another electron this changes into plutonium (Pu_{94}^{239}), which is used in one of the two types of bomb. The whole series of reactions is as follows:

$$n_0^1 + U_{92}^{238} \rightarrow U_{92}^{239} + \gamma$$

where γ represents gamma rays. Now, an electron is emitted with a half-life of 23 minutes:

$$U_{92}^{239} \xrightarrow[23\text{ min.}]{} Np_{92}^{239} + e_{1}^{0}$$

Neptunium also gives off an electron with a half-life of 2.3 days:

$$Np_{93}^{239} \xrightarrow[2.3\text{ days}]{} Pu_{94}^{239} + e_{-1}^{0}.$$

In general, any second electron is lost more slowly than the first, and the species formed finally, *e.g.* Pu_{94}^{239}, when it disintegrates, gives off α-particles. Plutonium disintegrates very slowly and for practical purposes is stable.

Positive electrons are transient. They have the same mass as ordinary negative electrons and are given off from a nucleus when one of its protons changes into a neutron:

$$p_{1}^{+1} \rightarrow n_1^0 + e_{+1}^0$$

Such positive electrons disappear very rapidly, since, when they meet negative electrons, their mass takes on the form of radiation and no electron is left:

$$e_{-1}^0 + e_{+1}^0 \rightarrow \gamma.$$

The atomic mass of the electron is 0.0005486 or 9.1×10^{-28} gram, so, since both electrons disappear, twice this amount of mass appears in the form of radiation of a frequency 2.5×10^{20} vibrations per second, which is a wave length of 0.012 A.

Gamma rays (γ-rays), which are practically x-rays of higher energy and thus of higher frequency, are given off very frequently in nuclear transformations. In some cases this is the only "disintegration," by means of which an intermediate excited nucleus changes into its stable form, as with carbon:

$$C_6^{12*} \rightarrow C_6^{12} + \gamma$$

Gamma rays may also play the part of projectiles to form an excited nucleus, which then disintegrates. For example, this may occur with beryllium, with the emission of a neutron:

$$Be_4^9 + \gamma \rightarrow Be_4^{9*} \rightarrow (Be_4^{8*} + n) \rightarrow 2\,He_2^4 + n_0^1$$

It is pointed out in an earlier section that an alpha particle, when captured by a nitrogen nucleus, gives an unstable (excited) fluorine nucleus of mass 18. At *relatively* low, though high, energies this disintegrates into hydrogen and oxygen of mass 17. However, at higher energies the excited nucleus disintegrates also into a positive electron, a neutron, and oxygen 17. That the products of the disintegration of any compound nucleus are dependent upon its state of energy is illustrated also in the relations of uranium; *e.g.* uranium 239 is produced from uranium 238 by the capture of a neutron. At very high energies this undergoes fission, but if the production of plutonium is desired, the best yields are obtained if neutrons are used which are relatively slow but lie in the resonance region located somewhat above that of thermal energy —that is, above that of the molecules in the atmosphere. The best yield of fission of uranium 235 is, however, obtained by the use of thermal, or low-velocity, neutrons.

A stable nucleus may be considered as having a definite amount of energy. When more energy is present, it is said to be in an excited state. Such a state is restricted to definite amounts of energy, known as energy states, of which there are a very great number. If a particle which is approaching a stable nucleus has just the definite amount of energy, kinetic and potential, which, added to that of the stable nucleus, gives exactly the energy of one of the energy states or "levels" of the compound nucleus which would be formed by the union of the two particles, then the probability of the union of the two particles is extremely high. This phenomenon is known as *resonance.* As the energy departs from that of the energy level, the probability of the union of the two particles decreases rapidly. Different resonance levels have different widths: *i.e.* at some levels the variation of energy for capture (or for emission) is much greater than at others.

It is found that different elements, when used with all of their isotopes present, capture neutrons of certain velocity much more than those which have other velocities. A region of energy in which this capture is more apt to occur is a resonance region of one of the isotopes. For example, cadmium exhibits a very marked capture of neutrons which are very slow, with an energy of 0.01 volt. With silver this rises to 1 ± 0.03 volts; with rhodium, to 3 volts; with iodine, to 50–300 volts; and with bromine, to 100–500 volts. Thus, when neutrons are shot through a thin sheet of any of these elements, neutrons of the energies listed are greatly reduced in number, while most of the neutrons of other energies pass through. Relations of this type may be used to control the reactions in the bomb.

X. DISCOVERY OF THE TRANS-URANIUM ELEMENTS

After the completion of the other sections of this paper the new elements 95 and 96 were announced on 16 November 1945, by G. T. Seaborg, the earlier discoverer of plutonium[3] (late in 1940). The first trans-uranium element, neptunium 239, was produced in May 1940, by E. M. MacMillan and P. H. Abelson, by the following procedure:

By a radiative capture of a neutron in uranium 236 an isotope of mass 239, (U^{239}) is formed. This emits a β-particle with a half-life of 23 minutes, giving neptunium of the same whole number mass 239 (since the loss of mass accompanying the emission of an electron is very small). Now, in general, in natural radioactivity the emission of one β-particle is followed by the emission of a second with a considerably longer life. In conformity with this relation the half-life of neptunium 239 was found to be 2.3 days, or 144 times longer than for the emission of the first β-particle. The first isotope of plutonium to be found was not that used in the atomic bomb, but was Pu^{238}.

First, U^{238} was bombarded in the cyclotron of E. O. Lawrence by the nucleus of heavy hydrogen (deuteron) of formula $(pn)_1^2$ and mass 2. Two neutrons escape, so the resultant effect is the addition of a proton:

$$U_{92}^{238} + (pn)_1^2 \longrightarrow Np_{93}^{238*} + n_0^1$$
$$Np_{93}^{238*} \longrightarrow Np_{93}^{238} + n_0^1$$
$$Np_{93}^{238} \xrightarrow[2.0\text{ days}]{} Pu_{94}^{238} + e_{-1}^0$$

The isotope of plutonium thus formed emits α-particles with a half-life of about 50 years.

More important is the isotope Pu_{94}^{239} used in the bomb. This is formed by the emission of a β-particle (2.3 days half-life) from the nucleus of the Np^{239} described above.

Recently, as mentioned above, elements 95 and 96 have been discovered by Seaborg and collaborators (R. A. James, L. G. Morgan, and A. Ghiorso) in work at the Metallurgical Laboratory, University of Chicago. Both U_{92}^{238} and Pu_{94}^{239} were bombarded by high energy (40 Mev) helium ions in Lawrence's 60-inch cyclotron, as rebuilt by J. G. Hamilton.

Information as to what isotopes were found has not been released, but it is very simple to indicate what excited compound nuclei are formed.

$$U_{92}^{238} + He_2^4 \rightarrow Pu_{94}^{242*}$$

If this emits β-particles, then

$$Pu_{94}^{242*} \rightarrow X_{95}^{242} + \beta$$
$$X_{95}^{242} \rightarrow Y_{96}^{242} + \beta$$

With plutonium the excited compound nucleus would be formed as follows:

$$Pu_{94}^{239} + He_2^4 \rightarrow Y_{96}^{248*}$$

The chemistry of elements 93 to 96 is of extremely great interest. At the present time, 97 elements, including the element of atomic number zero (its atoms are neutrons), are known. Of these 1 to 96 have outer electrons and the associated chemical properties, while 0 has no electrons and no chemical properties.

Seaborg has revealed a few of the chemical relations of the trans-uranium elements, whose properties are, on the whole, somewhat similar to those of uranium. They form a transition series, and in this sense resemble the rare earths, but especially the lower numbers of the series are much more easily raised to higher oxidation states (above III) than the rare earths.

Seaborg finds that 10^{14} parts of pitchblende contain 1 part of plutonium. From this it may be calculated that there is in the earth's crust about 1 atom of plutonium to 10 billion-billion atoms of the other elements. In this work he was assisted by M. L. Perlman.

XI. THEORY OF THE INTERMEDIATE OR COMPOUND NUCLEUS AND THE FISSION OF URANIUM AND PLUTONIUM

It is pointed out in the introduction that in a nuclear transformation the first step is the formation of an excited nucleus, as follows:

$$P + T \rightarrow C^* \qquad (1)$$

Then C^* must get rid of its excess energy by some type of change in which it loses energy, so:

$$C^* \rightarrow D + E.$$

If E is excited, a second disintegration occurs (Fig. 7). For the fission of uranium or of plutonium the first step is the formation of the excited nucleus which is to split into parts. This is done by the addition of a neutron (n_0^1), as follows:

$$U_{92}^{235} + n^1 \rightarrow U_{92}^{236*}$$
$$Pu_{94}^{239} + n^1 \rightarrow Pu_{94}^{240*}$$

Since the disintegration by fission of one of these is a process of the same type as that of the other, only the fission of U^{236} is considered here.

---

[3] Collaborators in the discovery of plutonium: E. M. MacMillan, A. C. Wall, and J. W. Kennedy.

In its fission the nucleus seems to split into two unequal parts of masses 127 to 154 for the heavier fragment and 115 to 83 for the lighter fragment. However, most of the masses lie between 134 to 144 for the heavier and between 90 and 100 for the lighter fragment. Inspection of Fig. 4 shows that for uranium 236 the ratio of neutrons to total particles in the nucleus is 0.61, while in the range of mass from 134 to 144 even the highest ratios are in general 0.6 or less, and for mass numbers 90 to 100 the highest ratios of any of the isotopes are about 0.584. Thus, if the two atoms formed in the end as the result of any fission have even the highest number of neutrons for stable isotopes, there are about five neutrons to be accounted for; if lower isotopes, more than five.

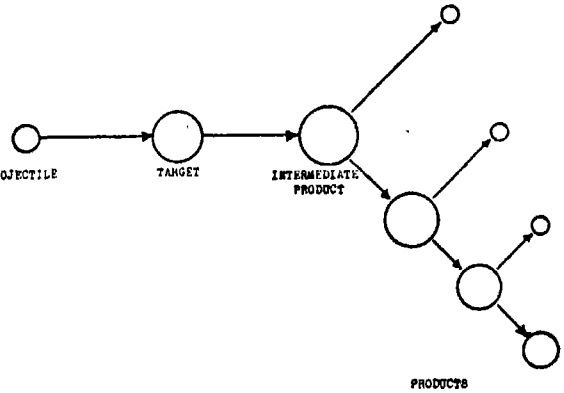


FIG. 7. A nuclear transformation in which several intermediate nuclei are involved.

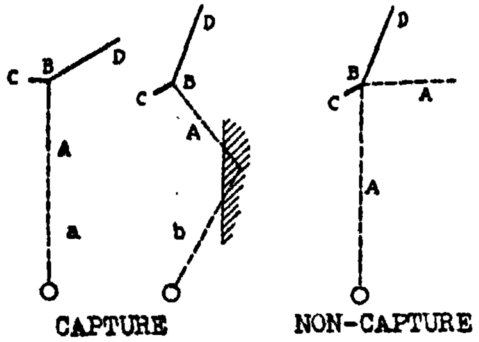
The process of fission may be considered analogous to what would occur if the water drop in air were to be set into strong vibration. This would result in the separation of the drop into two parts, but initially with a neck, or cylinder, of water between them. This, then, segregates into several minute water droplets. In the fission of uranium 236 it may be assumed that the process is analogous and that the droplets formed are neutrons, 1 to 3 in number. The loss of this number is not sufficient to allow the two atoms formed as fragments to be stable. Therefore, these nuclei must expel neutrons, but the expulsion may be "delayed" for a period of moderate length. Another method of getting rid of extra neutrons is for the neutrons in the nuclei to lose negative electrons, thus converting neutrons in the nuclei into protons. It may be supposed that the "delayed" neutrons observed to be given off after the fission occurs are emitted after the emission of one or more negative electrons, since the life of atoms in electron emission is much greater in general than that for neutron emission. Although the water-drop model is used above to illustrate fission, nuclei in general seem to be more closely similar to minute crystals.

The history of the discovery of the fission of heavy atomic nuclei into two nearly equal parts is of extreme interest but cannot be related fully here. The lightest atoms such as the neutron, the hydrogen atom, or the atom of heavy hydrogen have masses higher than their respective whole numbers, in the case of the neutron by 0.9 per cent, and for hydrogen of unit mass by 0.8 per cent. The atomic weight of oxygen is a whole number by definition. As the atomic mass becomes higher, it falls below that of the corresponding whole number with extreme slowness, but when barium of masses 130 to 138 is reached it has fallen to about 0.08 units below the whole number. Above this, the negative deviation from a whole number becomes smaller, so that, when mercury of atomic weight 200 is reached, it is almost exactly at the whole number again (mass 200 = 200.016). Above this, the positive departure from a whole number increases rapidly, and the mass of U^{236} may be given as 236.093.

Now, if U^{236} were to split into two parts, it would lose the excess over a whole number (.093) and also 0.08, the defect in the mass, or 0.173, which is the sum of these. However, on the average, two neutrons are lost in the process, and these have an excess mass of 0.018, so that the loss of mass experienced by any 235 grams of uranium used in the bomb would be 0.155. This multiplied by c^2 gives 1.4×10^{20} ergs, or 3.4×10^{13} calories. This amounts to 2.7×10^{20} ergs, or 6.6×10^{13} calories per pound. The temperature thus given by the bomb is many million degrees and the pressure many millions of atmospheres. However, the efficiency is not perfect, since not all of the uranium or plutonium atoms in the bomb undergo fission, and the temperature is so high that a considerable fraction of the energy may escape as radiation, which, although it gives pressure, is relatively ineffective as compared with the motion of the molecules.

Fermi became interested in the work on the disintegration of light atoms by neutrons, as presented in a paper by the writer at the Conference on Nuclear Physics at the University of Chicago in June 1933. In this paper Harkins, Gans, and Newson reported the discovery of the first artificially radioactive material ever produced, a nitrogen isotope of mass 16. A year later Joliot and Curie obtained a nitrogen isotope of mass 13, which they proved to be radioactive. Fermi had available at the University of Rome about fifty times more radium than was available at the University of Chicago, and was thus able to make a rapid survey of the effects of neutrons on a very large number of the heavier elements. This work gained him the Nobel Prize, which he merited on account of the discovery of the effects of slow neutrons and his earlier work in statistical mechanics. However, very unfortunately, the prize was granted for the discovery of the trans-uranium elements 93, 94, 95, and 96, the discovery of which is described in Section X of the present paper. What Fermi had actually found was the fission of uranium.

In all disintegration reported before 1939, one of the products was always a very light atom, for example, hydrogen of masses 1, 2, or 3, a neutron of mass 1, or helium of mass 4 (or 3). In January, 1939, however, Hahn and Strassmann described a repetition of Fermi's experiments on uranium. They obtained evidence, from the chemical nature and radioactive periods of the products, that one of the atomic species produced was barium with an atomic mass and number not far from half that of the uranium which disintegrates. Immediately after this, Frisch and Miss Meitner pointed out that this constituted the discovery of an entirely different type of nuclear reaction, in which the intermediate or compound excited nucleus splits into two parts of nearly equal mass.



a. Simple b. After Collision Does not occur

FIG. 8. Formation of an intermediate excited nucleus by capture of a neutron. In *b* the neutron is first deflected by an elastic collision with the nucleus of an atom. The right-hand section of the figure represents what would occur if, *according to the earlier ideas*, a disintegration were to occur by noncapture. *However, such a disintegration has never been found.*

Very shortly after this, numerous experiments by various investigators, Szilard, Zinn, Joliot, Halban, and Kowarski, combined to show that in each fission from one to three neutrons are liberated. This has been shown in an earlier section to agree with the relations presented in Fig. 4. However, it should be recognized that there is a second mechanism by means of which neutrons can disappear from an atomic nucleus, since, as shown earlier, when a negative electron is emitted by a nucleus a neutron in that nucleus is changed into a proton. The emission of negative electrons in this way is designated as artificial radioactivity, and the artificial radioactivity which occurs after the fission of a heavy nucleus is extensive.

During the years 1926–36 the writer obtained evidence, partly by experiment and partly from the literature, that the intermediate, or compound, nucleus is formed in all cases as a preliminary to disintegration. One of the first steps taken by Harkins and Gans in 1934 was to show that those disintegrations caused by neutrons assumed by members of the staff of the Cavendish Laboratory to occur by noncapture actually occur by capture (Fig. 8). By the development of a relativistic equation for disintegration by noncapture it was shown:

(1) That in none of the events assumed to occur in this way had there ever been enough energy to give a disintegration of this type. The simple form of this equation is presented here merely to show that the changes of mass involved in a disintegration must be considered:

$$V_A = \frac{\{M^2 + 2m_A[E_C + E_D + c^2(m_C + m_D - m_B)]\}}{2m_A M \cos \alpha}$$

Here V_A is the velocity of the projectile; M is the momentum; E is the kinetic energy; m, mass; c, the velocity of light; and A, B, C, and D are the nuclei involved.

(2) That the energies of the neutrons which were supposed to give noncapture disintegrations were found to lie on the same curve as those known to be of the capture type.

(3) That an intermediate compound nucleus is formed is shown clearly in events in which neutrons and protons are both given as the final products in two types of disintegration obtained from the same initial projectile and target. For example, if an intermediate, or compound, nucleus is formed by the addition of the helium nucleus to N^{14}, very few protons are emitted until the alpha particles have a somewhat high velocity, after which the number of protons emitted rises very rapidly with the velocity of the alpha particle and then quickly reaches a constant value, which, however, soon begins to decrease. Just as this decrease begins to appear, neutrons are found to be given off by the disintegration. The number of neutrons now increases at the same rate as the yield of protons decreases, which shows most clearly that in such transformation there is no direct coupling between the initial alpha particle and the protons and neutrons formed as the final products of the disintegration. The formation of protons and of neutrons are thus disintegrations of the compound nucleus, which compete with each other, the increase in one giving a decrease of the other.

One of the most prominent properties of the neutron, due to its absence of charge, is that it can pass through an enormous number of other atoms without deflection, unless it strikes a nucleus. Since, on the average, about two neutrons are emitted by each fission and only one is needed to produce it, and since, in addition, the reaction is exceedingly fast, the number of neutrons and also the number of fissions increases with extreme rapidity, provided no neutrons escape. However, unless the body is moderately large, so many neutrons escape that, on the average, less than one of the neutrons produced by a fission is effective in uniting with a nucleus to give another fission, so the reaction dies out. If the body is larger than this (known as the critical volume highly dependent upon the shape), the reaction proceeds. In such a case the term, chain reaction, has been employed, although this is somewhat different from the prior use of this term in chemistry.

The writer realized not very long after the beginning of the development of his general theory of nuclear transformation, in 1926, that the complete theory is of the quantum-mechanical type. Such an enlargement of the theory was developed in 1937 by Bohr and Kalckar (*2*). However, this was not done until the point of view of nuclear physicists in general was changed by experimental evidence, which demonstrated that the *primary* process is the formation of a nucleus, rather than its disintegration.

References

1. BETHE, H. A. *Phys. Rev.*, 1936, **50**, 332.
2. BOHR, N., and KALCKAR, F. *Math-fys. Meddel.*, 1937, **14**, 10.
3. HARKINS, W. D. *J. Amer. chem. Soc.*, 1921, **43**, 1042.
4. HARKINS, W. D., and WILSON, E. D. *Phil. Mag.*, 1915, **30**, 723.
5. MCCOY, H. N., and ROSS, W. H. *J. Amer. chem. Soc.*, 1907, **29**, 1711.

Obituary

Thomas J. Maney
1888-1945

Last 12 October marked the passing of T. J. Maney, chief in pomology at Iowa State College. His death occurred at Rochester, Minnesota, where he had undergone an operation.

Maney was born at Geneva, New York, on 24 April 1888. He gained his inspiration for horticulture under the tutelage of Professor S. A. Beach and graduated from Iowa State College in 1912. He was employed by the college immediately following his graduation, in which relationship he continued for the past third of a century. He served as chief in pomology at this institution since 1917. His special field was hardy stocks for the pomaceous fruits. His genial fellowship and keen Irish wit will be missed by his college associates.

Mr. Maney is survived by his wife and three sons, one of whom is in the Army Air Corps.

A. T. ERWIN

Iowa State College

Bruce Lawrence Clark
1880-1945

Dr. Bruce Lawrence Clark, associate professor of paleontology, emeritus, of the University of California and one of the country's outstanding authorities on invertebrate paleontology, died on 23 September 1945 at his home, 916 Euclid Ave., following a six-month illness. His death will be mourned by hundreds of his former students in all parts of the world, who held him in affectionate regard as a friend as well as an instructor.

Dr. Clark graduated from Pomona College in 1908 and received his Master of Arts degree and his Ph.D. degree at the University of California in 1909 and 1913, respectively. He joined the university faculty as a teaching fellow in 1909. He became an associate professor in 1923.

On the Berkeley campus, Dr. Clark developed a school of graduate students who went out to all parts of the world to develop the vast oil fields in Arabia, Sumatra, Java, Borneo, Colombia, Venezuela, and Mexico. He himself traveled extensively in Europe and Mexico visiting other scientists in his field.

His principal interest was in the invertebrate fossils of the Pacific Coast and he had recently discovered radiolarian deposits from the Eocene period in the region of Mount Diablo. He was a member of the American Association for the Advancement of Science, the Paleontological Society, the Geological Society of America, the California Academy of Sciences, the Faculty Club, and the First Congregational Church of Berkeley.

Dr. Clark was born in Humboldt, Iowa, on 29 May 1880. He is survived by his wife, Mrs. Delia E. Clark, a daughter, 2d Lt. Elizabeth Clark of the Army Nurse Corps at DeWitt General Hospital at Auburn, California, and a son, Bruce E. Clark, CM1/c USNR, now home from Okinawa.

CHARLES L. CAMP

University of California, Berkeley

The Effect of B-Pyracin and the *Lactobacillus casei* Factor Upon Hemoglobin Regeneration Following Hemorrhage[1,2]

M. L. Scott, L. C. Norris, and G. F. Heuser
Agricultural Experiment Station and School of Nutrition, Cornell University

Recently Scott, Norris, Heuser, and Bruce (*4*) reported that the macrocytic hypochromic anemia which develops in chicks fed a purified diet is prevented by administration of the crystalline *Lactobacillus casei* factor (LCF) of Hutchings, Stokstad, Bohonos, and Slobodkin (*2*) together with either the lactone of 2-methyl-3-hydroxy-4-hydroxymethyl-5-carboxypyridine (α-pyracin lactone) or the isomeric 4-carboxy lactone (β-pyracin lactone).[3] Kornberg, Tabor, and Sebrell (*3*) have shown that the crystalline LCF of Hutchings and associates (*2*) has a preventive and corrective action on hemorrhagic anemia in rats fed a purified diet containing succinyl sulfathiazole.

Since, in the chick, LCF and pyracin appear to be concerned in hematopoiesis under conditions of malnutrition, the question arose as to whether or not injections of these factors might speed up hematopoiesis in times of great need, as for instance, after severe hemorrhage, even when the subjects are receiving a good diet. Experiments were conducted, therefore, to determine if it is possible to hasten hemoglobin regeneration, following severe hemorrhage, by intramuscular injections of LCF and β-pyracin. The results of these experiments are presented in this report.

Three different experiments were conducted using a total of 34 White Leghorn hens in active egg production. Each hen was kept in an individual wire cage in a heated room and fed a commercial diet throughout the experiment. The hens were rendered anemic by withdrawal of blood from the heart with a Luer's syringe. The amount withdrawn was calculated to be approximately one-third of the hen's total blood supply. The blood withdrawal had no effect upon the rate of egg production.

After bleeding, the hens in each experiment were separated into four groups. Group 1 acted as the control and received no therapeutic treatment. Group 2 received 50 γ of β-pyracin[4] per hen, by intramuscular injection, 24 hours after bleeding and subsequently every 24 hours until termination of Experiments 1 and 2, and until the fourteenth day of Experiment 3. Similarly, Group 3 received 50 γ of LCF,[5] and Group 4 received 50 γ each of β-pyracin and LCF per hen per day.

Hemoglobin values were determined for each hen before the experiments were started. Hemoglobin determinations were also made just prior to injection, 24 hours after bleeding, and, in like manner, daily thereafter until the injections were discontinued.

TABLE 1

Hemoglobin Values Obtained in Hens Administered B-Pyracin and *Lactobacillus casei* Factor (LCF) After Hemorrhage

Treatment	No. hens per lot	Hemoglobin before bleeding grams/100 cc.	Hemoglobin after bleeding by 24-hour intervals grams/100 cc.								
			1	2	3	4	5	6	7	8	9
Experiments 1 & 2 (Preliminary)											
Control ...	6	8.6	5.7	6.4	5.6	6.2	6.4	6.7	6.8	7.8	..
β-pyracin .	5	8.2	5.7	5.6	6.2	6.8	7.0	8.0	7.7	8.2	..
LCF	5	8.1	5.9	6.2	6.6	6.5	7.1	7.6	7.9	8.5	..
β-pyracin + LCF ...	6	8.6	5.7	6.1	6.6	7.4	7.8	9.0	9.4	9.7	..
Experiment 3											
Control ...	3	7.5	4.5	4.4	4.8	4.2	5.4	5.6	5.8	5.8	6.0
β-pyracin .	3	7.5	4.6	5.6	6.5	7.1	6.8	6.7	6.5	8.1	8.0
LCF	3	7.7	4.9	5.6	5.9	6.4	6.4	7.5	7.2	7.9	7.5
β-pyracin + LCF ...	3	7.9	4.9	5.6	6.1	7.1	7.3	8.1	8.8	8.9	9.7

The "pre-bleeding" hemoglobin values obtained on these experiments were lower than the value of 9.8 grams per 100 cc. of blood reported to be normal for the hen by Dukes and Schwarte (*1*). We have obtained values on hens receiving the same diet, but not in active egg production, which are in agreement with the value reported by these workers.

---

[1] This work was aided by grants to Cornell University by the Western Condensing Company, San Francisco, California, and the Wyeth Institute of Applied Biochemistry, Philadelphia, Pennsylvania, and was conducted in the nutrition laboratories of the Department of Poultry Husbandry. The paper was submitted in July 1945.

[2] The technical assistance of R. F. Ball is gratefully acknowledged.

[3] Unpublished studies conducted in this laboratory, together with the data presented here in Experiment 3, show that both the acid and the lactone forms of these compounds are active, nutritionally. Therefore, due to its connotation, the name pyracin will henceforth be applied to the acid forms, while the lactone forms will be referred to as pyracin lactones.

[4] We are indebted to Merck and Company, Rahway, New Jersey, for the crystalline β-pyracin lactone used in Experiments 1 and 2. The lactone was converted to β-pyracin for use in Experiment 3 by refluxing 5 mg. in 20 cc. of 0.05N NaOH for 15 minutes.

[5] We are indebted to Dr. E. L. R. Stokstad and Dr. B. L. Hutchings, of Lederle Laboratories, Pearl River, New York, for the crystalline *Lactobacillus casei* factor used in these studies.

The results of the hemoglobin determinations which are presented in Table 1 show that the administration of either β-pyracin or LCF alone is of some value in hastening the regeneration of hemoglobin after severe hemorrhage, but that the administration of both these factors together is markedly more effective, causing a return of the hemoglobin level to the "pre-bleeding" value in five to six days, whereas in the hens receiving no treatment only a slight increase in hemoglobin level was observed in that length of time. Furthermore, the hemoglobin level in the hens receiving both β-pyracin and LCF continued to rise in all experiments and reached the normal level in eight to nine days, while the controls showed an increase in hemoglobin of approximately 1.5 grams per 100 cc. of blood in the same period of time.

In Experiment 3, the hens were held after the vitamin injections were discontinued and periodic hemoglobin determinations were made in order to ascertain the ultimate effect of the removal of approximately one-third of the blood supply. The results are presented in Fig. 1. The results show that in all cases the hemoglobin levels rose above the "pre-bleeding" values and then declined to approximately the original level. The rate of increase was much more rapid and the level reached was higher in the lot receiving both β-pyracin and LCF than in the other lots. In this lot and the lots receiving β-pyracin and LCF singly, the higher hemoglobin levels were maintained for some time before declining. The rise in hemoglobin levels above the "pre-bleeding" values, which was observed in all lots, may possibly be explained by an overcompensatory activity of the hematopoietic organs under conditions of extreme demand.

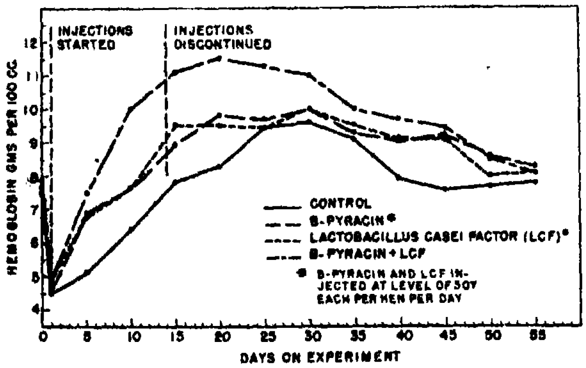


FIG. 1. Effect of injected β-pyracin and *Lactobacillus casei* factor upon the rate of recovery from hemorrhagic anemia.

SUMMARY

In severe experimental hemorrhagic anemia in hens, the injection of β-pyracin and *Lactobacillus casei* factor, alone and in combination, was found to hasten the regeneration of hemoglobin. When these factors were administered together, however, the rise in hemoglobin was much more rapid and the level reached was higher than in the lots administered the factors alone.

The hemoglobin levels in the control lots rose above the "pre-bleeding" values and then began an almost immediate decline to approximately the original level. In the lots receiving β-pyracin and *Lactobacillus casei* factor, alone or in combination, the hemoglobin levels also rose above the "pre-bleeding" values but were maintained for some time after injections were discontinued before declining to the original values.

References

1. DUKES, H. H., and SCHWARTE, L. H. *Amer. J. Physiol.*, 1931, **96**, 80.
2. HUTCHINGS, B. L., STOKSTAD, E. L. R., BOHONOS, N., and SLOBODKIN, N. H. *Science*, 1944, **99**, 371.
3. KORNBERG, A., TABOR, H., and SEBRELL, W. H. *Amer. J. Physiol.*, 1944, **142**, 604.
4. SCOTT, M. L., NORRIS, L. C., HEUSER, G. F., and BRUCE, W. F. *J. biol. Chem.*, 1945, **158**, 291.

The Site of Action of DDT in the Cockroach[1]

KENNETH D. ROEDER and ELIZABETH A. WEIANT

Department of Biology, Tufts College

Yeager and Munson (*4*) have obtained indirect evidence that DDT (*1*-trichloro-2,2-bis(*p*-chlorophenyl)-ethane) may act on motor nerve fibers of the cockroach, raising their irritability until spontaneous discharges result in muscle twitches. Others have confirmed this, observing the twitching which occurs in amputated DDT-treated legs.

If an emulsion[2] containing 5 μg. DDT is injected into the body cavity of an adult cockroach (*Periplaneta americana*) weighing 1.0 to 1.5 grams, the insect shows typical symptoms of poisoning within 5 or 10 minutes. Briefly, the symptoms consist of coarse clonic spasms of the trunk and appendicular muscles and increased but initially well-coordinated activity. Within a few hours the spasms become continuous and the insect is unable to stand, although the legs may continue to twitch feebly for 48 hours.

The dose producing tremors within 5 to 10 minutes is in the neighborhood of 5 to 10 mg./kg. If it is assumed that DDT is distributed evenly among the body tissues, the toxic concentration at the site of action must be approximately 5 parts per million. Even if DDT is selectively accumulated in certain

---

[1] The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Tufts College.

[2] Twenty ml. of an oil solution (petrolatum mineral oil, 90.5 per cent; oleic acid, 8.5 per cent; and DDT, 1.0 per cent) is passed through a hand emulsifier with 80 ml. of an aqueous solution (insect saline, 99.0 per cent; triethanolamine, 1.0 per cent). The emulsion minus DDT had no effects on cockroaches.

tissues, it seems improbable that the toxic concentration at the site of action is more than 10 times greater or less than this figure. The following experiments were carried out in order to discover a site of action sensitive to a direct application of DDT in an approximate concentration of 0.5 to 50 ppm.

Motor nerves and muscles. Yeager and Munson found that the injection of a 10-per cent solution of DDT in corn oil locally into the leg of a roach, or into the region of the ganglion of the same segment, produced twitching in the leg muscles within 5 to 10 minutes even after the motor nerves had been severed medial to the injection site. If DDT emulsion (1,600 ppm DDT) is applied directly to the exposed, intact internal ventral muscles of the cockroach after removal of the abdominal ganglia, a series of isolated and often partial contractions of the individual fibers can be observed. These contractions were noted only one to three hours after exposure to emulsion containing 1,600 ppm DDT. In view of the times of onset and high concentration of DDT necessary, it seems doubtful that the direct action of DDT on muscles or on the peripheral stumps of motor nerves can account for the symptoms observed in the intact insect.

Central nervous system. Since decapitation or separation of the body segments causes no decrease in DDT tremors, no specific nerve center can be affected. To determine whether DDT has a general excitatory effect on the central nervous system, the thoracic ganglia were dissected in saline and mounted on silver electrodes. The spontaneous electrical activity was amplified and counted electrically over continuous periods of many hours. This method has been used previously to study the central action of excitant and depressant drugs and ions (*3*). Application of solid DDT crystals, 2 per cent DDT in mineral oil, and DDT in emulsion (1,600 ppm) had no detectable effect on the level of spontaneous activity. In view of the concentrations used, the central action of DDT, if any, is of no significance in the genesis of typical DDT tremors.

Sense organs. Silver electrodes were placed in contact with an exposed section of the ventral nerve cord of an otherwise intact cockroach. Potentials were fed to a Grass amplifier and recorded with a cathode-ray oscilloscope and camera. Impulses were also counted electrically and monitored with a loudspeaker. The number of impulses per second became relatively constant except during struggles of the insect. If an effective dose of DDT was injected, the number of impulses per second increased 700 per cent as the typical symptoms of poisoning developed. Sectioning the cord above and below the site of the electrodes revealed that the DDT-induced impulses were in ascending fibers. Since the ganglia themselves are not apparently affected by DDT, the ascending impulses must be sensory in origin.

To obtain direct evidence of a sensory effect, the large crural nerve in the metathoracic segment was exposed from its root at the ganglion to the point where it enters the coxa. This nerve is designated as nerve 5 by Pringle (*1*) who showed by physiological methods that it contains afferent fibers from the campaniform sensilla and the hair sensilla in the leg, and a few efferent fibers to the muscles of the coxa. Using a manipulator, two silver electrodes were placed below the nerve between the ganglion and coxa. The electrode nearest the ganglion was pinched tightly around the nerve to crush it at this point. This prevented the nerve from slipping off the electrodes and rendered the afferent impulses monophasic. To eliminate any possibility of motor activity the ganglion was removed, and all other nervous connections with the leg were severed.

Normal electrical activity in the afferent fibers consists of a steady asynchronous series of axon spikes, which is replaced by a complex high-frequency burst of impulses if the leg is moved passively or the coxa and femur are subjected to torsion (*1*). The electrical picture is similar but somewhat simplified if the distal third of the femur is amputated. If DDT emulsion is injected into the cut end of the femur so that the solution passes completely through the leg, there is an immediate and striking change in the electrical activity. In place of the random spikes, a series of impulse trains appears and persists for hours. Each train seems to involve a single fiber which fires repetitively at a frequency of 300 to 400 spikes per second. The train declines slightly in frequency and dies out in 0.1 to 0.5 seconds. The spike height in each train is constant, indicating the involvement of a single axon, although a number of different trains may occur simultaneously. Comparison with normal oscillograms suggests that while the untreated sense cell discharges a single spike at various intervals, under the influence of DDT each single spike is replaced by a short train, likewise repeated at intervals. Even at the height of the DDT-induced discharge no spontaneous movements of the leg were detected in well over 100 preparations and the increased electrical activity seems to be confined to the afferent fibers.

Trains appear in the afferent fibers when solutions containing as little as 0.01 ppm DDT are perfused through the leg. Effects have been obtained with diluted DDT emulsion, suspensions of DDT made by a series of saline dilutions from a 1-per cent solution of DDT in ethyl alcohol, and a saturated aqueous solution of DDT in saline made by allowing saline to stand in contact with pure DDT crystals overnight at 22° C. The time interval between perfusion and the appearance of trains is related to the DDT concentration perfused (Table 1), and comparison of the figures suggests that the DDT concentration in the aqueous solution was between 0.1 and 0.01 ppm. Although the trains take longer to appear at very low concentrations, they may be marked and persistent.

TABLE 1

	Diluted emulsion			DDT suspension in saline				Saline saturated with DDT
DDT in ppm	16.0	1.6	0.16	10.0	1.0	0.1	0.01	?
Individual times (in minutes) from perfusion to appearance of trains	3.0	4.0	16.0	3.0	10.0	13.0	48.0	20.0
	7.0	8.0	9.0	2.0	3.0	21.0	52.0	42.0
			13.0	3.0	2.0	32.0	36.0	35.0
			25.0	4.0	12.0	19.0	32.0	12.0
				3.0	10.0	23.0	27.0	30.0
					16.0	31.0	31.0	
					18.0		29.0	
					17.0		32.0	
					9.0			
Av. times			16.0	3.0	9.6	23.1	35.2	27.8

The sensitivity of the sensory response is such that the DDT concentrations reached within the body of a cockroach receiving the minimum lethal dose would be more than sufficient to generate similar trains of impulses in the afferent nerves. It is concluded that in the cockroach the tremors characteristic of DDT poisoning are due to an intense and patternless bombardment of the motor neurones by trains of impulses originating in sensory endings.

It has not been possible to identify the sensory structures upon which the DDT acts. Progressive amputation of the leg reveals that both normal electrical activity and DDT trains disappear if the trochanter is removed, although a considerable length of nerve 5, including several motor branches, remains intact in the coxa. Removal of the trochanter would eliminate all the groups of campaniform sensilla described by Pringle, and the general impression gained is that the proprioceptive sense organs are the structures in which the DDT trains originate. A similar series of trains can be obtained if DDT is injected into the cut cercus, and the electrical activity in the cercal nerve is recorded. The DDT trains are much less marked in this nerve and are somewhat masked by a large, spontaneous background of electrical activity which seems to be unaffected by DDT. Although campaniform sensilla are located on the cercus, they are greatly outnumbered by hair sensilla sensitive to air currents and sound vibrations (*2*). This suggests that DDT does not have its characteristic effect on all sensory structures, but acts to some extent specifically on a particular group of sense organs, as yet unidentified.

SUMMARY

(1) Although DDT undoubtedly affects motor nerves and muscle fibers in concentrations greater than 1,000 ppm, this action cannot be directly responsible for the clonic tremors in the DDT-poisoned cockroach which can be produced by internal concentrations of the order of 5 ppm.

(2) DDT has no significant action on the cockroach central nervous system.

(3) DDT emulsion perfused through the leg of the cockroach in concentrations as low as 0.01 ppm causes the appearance of a series of high frequency trains of axon spikes in the afferent fibers.

(4) It is concluded that the tremors characteristic of DDT poisoning are due to an intense afferent bombardment of the motor neurons.

References

1. PRINGLE, J. W. S. *J. exp. Biol.*, 1938, **15**, 144; 1939, **16**, 220.
2. PUMPHREY, R. J., and RAWDON-SMITH, A. F. *Proc. roy. Soc.*, 1937, **B122**, 106.
3. ROEDER, KENNETH D., and ROEDER, SONJA. *J. cell. comp. Physiol.*, 1939, **14**, 1; Roeder, K. D. *J. cell. comp. Physiol.*, 1941, **18**, 1.
4. YEAGER, J. K., and MUNSON, S. C. *Science*, 1945, **102**, 305.

Molecular Weights and Other Properties of Viruses as Determined by Light Absorption

GERALD OSTER

The Rockefeller Institute for Medical Research
Princeton, New Jersey

Virus solutions exhibit visible opalescence due to light scattered by the virus particles, and this results in a decrease in light transmission. It can be shown by an application of Einstein's theory of light-scattering of mixtures (*1*) that the molecular weight, M, of uniform spherical particles, small compared with the wave length of light, λ, is given for dilute solutions by the expression $M = 1.69 \times 10^{22} \dfrac{D\lambda^4}{c\left(\dfrac{\partial n^2}{\partial c}\right)^2}$, where c is the concentration of the particles expressed in grams per milliliter of solution, D is the optical density (the absorption coefficient divided by 2.303 for a cell of 1 cm. thickness) of the solution, and n is the index of refraction of the solution. Since $\dfrac{\partial n^2}{\partial c}$ is nearly equal to $2n_0 \left(\dfrac{n-n_0}{c}\right)$, where n_0 is the index of refraction of the medium, the latter expression can be used. Therefore, it is possible to secure molecular weight values if, for dilute solutions, the change in optical density with wave length and the indices of refraction of the solvent and solutions are known. In the present experiments the indices of refraction were determined by means of a Zeiss dipping refractometer, and the light absorption of the solutions was measured in a spectrophotometer at various wave lengths and concentrations. From the slope of the straight-line portion of the curve of D *versus* $\frac{1}{\lambda^4}$ extrapolated to infinite dilution and from the index of refraction of the solution, the molecular weight of the particles in solution is obtained.

The method just described was used in studies with two virus preparations known to possess quite different particle sizes. One of these was the PR8 strain of influenza virus, which has been found to consist of particles about 100 mμ in diameter (*3*), and the other was tomato bushy stunt virus, which has been found to consist of particles about 26 mμ in diameter (*7*). The influenza virus was obtained from infectious allantoic fluid of the developing chick embryo and was purified by a combination of the methods of adsorption on, and elution from, chicken red cells and differential centrifugation recently described by Knight (*2*). The bushy stunt virus was obtained from diseased *Datura stramonium* plants and purified by differential centrifugation as described by Stanley (*6*). The results for aqueous solutions of the two highly purified virus preparations are given in Figs. 1 and 2. The absorption, expressed in terms of the optical density, D, is referred to water as the zero value. For longer wave lengths, D is linear in $\frac{1}{\lambda^4}$, indicating that the absorption is due to Rayleigh light scattering. For shorter wave lengths, where the influenza virus particles are comparable in dimensions with the wave length, there is a decrease in scattering with a deviation from Rayleigh's law as predicted by a theory of Mie (*4*). In the case of the much smaller particles of bushy stunt virus, where the particles are small compared with the shorter wave lengths, there is an increase in absorptions above that of the Rayleigh law because of the high percentage of nucleic acid in this virus (*6*). This component has an absorption spectrum which extends into the visible region.

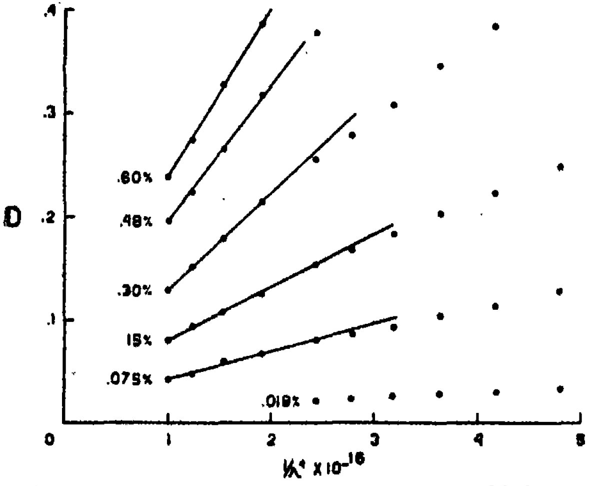


FIG. 1. Light absorption of aqueous solutions of influenza virus as a function of inverse fourth power of the wave length.

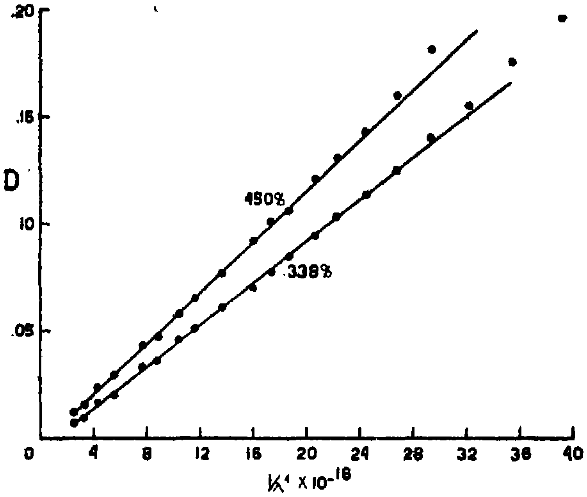


FIG. 2. Light absorption of aqueous solutions of tomato bushy stunt virus as a function of inverse fourth power of the wave length.

From the slopes of the straight-line portion of the curves of D *versus* $\frac{1}{\lambda^4}$ for influenza virus and bushy stunt virus, shown in Figs. 1 and 2, and from the indices of refraction of the virus solutions, molecular weight values of 322 million and 9.0 million, respectively, can be calculated. In this method no assumptions need be made about the percentage of hydration of the particles. Lauffer and Stanley (*3*) found the density of influenza virus to be about 1.1. Using this density and the value of the molecular weight of influenza virus determined by the light absorption method, a diameter of 97 mμ is obtained. This value agrees well with estimates of the size of the virus obtained in ultracentrifugation and electron microscope studies (*6*). The molecular weight of bushy stunt virus obtained from the light absorption method agrees well with estimates made by Neurath and Cooper (*5*) and by Stanley and Lauffer (*7*) from ultracentrifugation and diffusion studies.

The light-scattering, and therefore light-absorptive, powers of solutions are very sensitive to changes in particle size, shape, and interaction. For example, the method was used to determine the isoelectric point from the point of maximum coagulation of the virus.

particles. A typical curve is illustrated in Fig. 3, which shows the absorption as a function of volume of 0.001 molar HCl added to 5 cc. of a 0.2-per cent solution of tobacco mosaic virus in water. The solution corresponding to the maximum in the curve has a pH of 3.9, which agrees with the isoelectric point as measured with the same solutions by means of a microelectrophoresis apparatus. It is also possible, by using the light-absorption method, to distinguish between the isoelectric points of tobacco mosaic virus and many of its strains. The optical method is being used to study irreversible polymerization and the formation of liquid crystals of tobacco mosaic virus. The method seems to show promise in studies on antibody-antigen reactions involving viruses as the antigens.

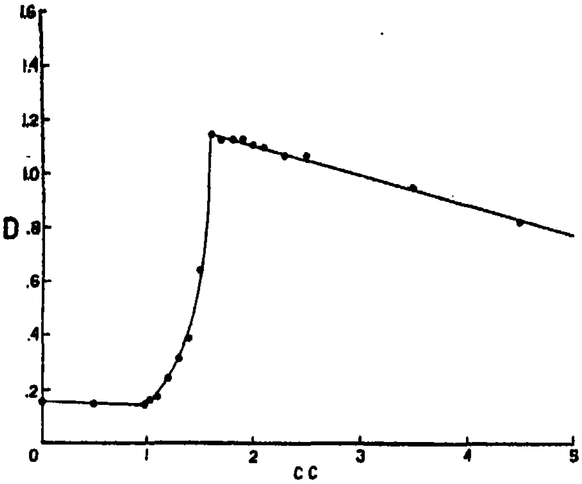


FIG. 3. Light absorption at a wave length of 400 $m\mu$ of 5 cc. of a 0.2-per cent aqueous solution of purified tobacco mosaic virus upon addition of 0.001 M HCl.

References

1. EINSTEIN, A. *Ann Phys.*, 1910, 33, 1275.
2. KNIGHT, C. A. *J. exp. Med.*, 1946, 83, 11.
3. LAUFFER, M. A., and STANLEY, W. M. *J. exp. Med.*, 1940, 80, 507.
4. MIE, G. *Ann. Phys.*, 1908, 25, 37.
5. NEURATH, H., and COOPER, G. *J. biol. Chem.*, 1940, 135, 455.
6. STANLEY, W. M. *J. biol. Chem.*, 1940, 135, 437.
7. STANLEY, W. M., and LAUFFER, M. A. *J. biol. Chem.*, 1940, 135, 463.

News and Notes

AAAS Meeting Notes

The Council on Methodology of Science under the chairmanship of Paul Weiss, University of Chicago will hold a Friday morning session, 29 March, 9:30 A.M. in private dining room 6, Jefferson Hotel. A group of invited scientists will discuss some of the emerging problems which, with the rapid expansion of scientific domain, confront investigators, educators, editors, and administrators. The discussion will center on such subjects as the relation between fundamental and developmental research, standards of research performance, and independent versus directed research.

The Conservation Council under the chairmanship of Charles C. Adams, New York State Museum, Albany will hold a Saturday afternoon session, 30 March, 2:00 P.M.; private dining room 5, Jefferson Hotel. An informal conference has been called by the temporary officers of the Conservation Council to discuss suggestions and plans for the formation of a permanent organization devoted to the integration of active interest in organizations within the general field of conservation.

The Society for the Study of Speciation will hold a Saturday morning session, 30 March, 8:30 A.M. in private dining room 2, Jefferson Hotel under the chairmanship of Alfred E. Emerson. The Society for the Study of Speciation is a new group first organized in 1941 for those interested in the dynamics of evolution. In preparation for a fresh start, following an inactive period during the war, this meeting is called to discuss organization and objectives and to elect officers.

About People

Dr. Carlyle F. Jacobsen, formerly professor of psychology and assistant dean of the Washington University School of Medicine, St. Louis, has been appointed dean of the Graduate College at the State University of Iowa, effective 1 April.

Dr. Roger Adams, head of the Department of Chemistry in the University of Illinois and member of the *Science* policy committee, has been awarded the Davy Medal of the Royal Society of London. Dr. Adams, who spent the war years in Washington with NDRC, is now in Berlin as special adviser to Lt. Gen. Lucius D. Clay, deputy military governor of the American occupation zone in Germany.

Dr. Adams served the AAAS on the Executive Committee 1940–1945, has been vice-president of Section C, was president of the American Chemical Society in 1935, and is now chairman of its Board of Directors.

Dr. William C. Biel has joined the Denison University faculty as associate professor of psychology and director of special projects in industrial research at Newark, Ohio.

Dr. Richard V. Morrissey has been appointed assistant professor of biological sciences at Denison University.

Glenn L. Jepsen, associate professor, Princeton, has been appointed to the William J. Sinclair professorship of vertebrate paleontology in the Department of Geology at Princeton, effective at the beginning of the academic year 1946–1947. This is the first appointment on this professorship, which was established in honor of William J. Sinclair, who served as professor of vertebrate paleontology at Princeton from 1916 to 1935.

Benjamin Burack has been appointed assistant professor of psychology at Roosevelt College, Chicago.

Dr. Steuart Henderson Britt, until recently a Lt. Commander, USNR, serving in the Headquarters of the Commander in Chief, U S. Fleet, has become the associate director of research of McCann-Erickson, Inc.

Dr. Edward Asahel Birge, president emeritus of the University of Wisconsin, recently celebrated his seventieth year of continuous service. On 5 January 1875 Dr. Birge came to the University of Wisconsin, at the age of 24, as an instructor in natural history. Now 94 years of age, Dr. Birge is considered "the grand old man" of Wisconsin's and America's scientists-scholars-educators. Still in good health, he spends part of each day, even though he technically retired 21 years ago, at work in his office in the biology building on the Wisconsin campus. He learned to operate a typewriter as he approached his ninetieth birthday and still does much of his own typing. At present he is working on a volume on the physical, chemical, and biological conditions of Wisconsin's lake waters, a field in which he has specialized since retiring as president of the University in 1925.

Dr. Sidney M. Newhall, formerly technical director of the Fire-Control Research Laboratory at the Foxboro Company, is now in charge of psychological research in the Color Control Department of the Eastman Kodak Company.

Dean A. M. Schwitalla, S.J., of St. Louis Medical School, will be the speaker at the Graduation Exercises of the University of Texas Medical Branch, Galveston, on Saturday, 2 March.

Ian Campbell has returned to his position as associate professor of petrology and associate chairman of the Division of the Geological Sciences at the California Institute of Technology in Pasadena. During his leave of absence from the California Institute, Dr. Campbell served as a senior training engineer and as chief of the editorial section for the University of California, Division of War Research, at the U. S. Navy Radio and Sound Laboratory in San Diego.

Morris A. Stoltz, formerly chief chemist of the Anglo-French Laboratories, consultant to E. Fougera and Company, and chemist of the Loeser Laboratory, is now chief chemist in charge of ampule production at the Leader Laboratory, Brooklyn, New York.

Lt. Col. Harry E. Carnes, M.C., has returned from the armed forces and is now in the Division of Biological Production at Parke, Davis and Company, Detroit, Michigan.

Lt. Robert L. Burwell, Jr., has returned to Northwestern University as assistant professor of chemistry after three years of active duty in the Navy. During most of this period he was attached to the Chemistry Division of the Naval Research Laboratory, Washington, D. C.

Charles V. Crittenden, formerly with the U. S. Office of Strategic Services, has been appointed assistant professor of geography at Ohio State University. Prof. Crittenden was attached to the map intelligence office of OSS for three and a half years, with about 18 months service in Switzerland and Italy in the procurement of special maps.

Marcel Raymond, botanist, assistant secretary of the Association Canadienne Française pour l'Avancement des Sciences, has arrived in Montreal from Paris, where he was delegated to assist at the first congress of the French Association for the Advancement of Science held since the beginning of the war, in October last.

Dr. Valy Menkin, Department of Pathology, Duke University School of Medicine, addressed the Baltimore Medical Society on 1 February 1946 on "Chemical Factors and Their Role in Inflammation."

Dr. Irwin M. Korr has been appointed professor of physiology at the Kirksville College of Osteopathy and Surgery.

Dr. Lawrence C. Curtis, geneticist on the staff of the Connecticut Agricultural Experiment Station at New Haven since 1930, has joined the faculty of the University of Connecticut, Storrs, to do research and teaching as associate professor of horticulture.

William R. Bascom is now an assistant professor in the Department of Anthropology at Northwestern

University. He has just returned from three years with the Foreign Economic Administration as special representative to British West Africa, with headquarters in Accra.

Dr. Robert M. Moore, professor of surgery, has recently returned to the Medical Branch of the University of Texas after services in the European theater.

Dr. M. F. Guyer, emeritus professor of zoology at the University of Wisconsin, has been made a lecturer in genetics at the University of Texas Medical Branch, Galveston.

The New Year Honors List, published in *The Times*, London, 1 January 1946, reveals that Prof. A. V. Hill, Sc.D., F.R.S., a secretary of the Royal Society, was appointed a companion of honor. Other orders were conferred on Mr. W. A. Akers, director of atomic bomb research, Department of Scientific and Industrial Research (knight bachelor); Sir Edward Victor Appleton, F.R.S., secretary, Department of Scientific and Industrial Research (G.B.E.); Clive Forster-Cooper, F.R.S., director, British Museum of Natural History, (knight bachelor); Harold Arthur Thomas Fairbank, consultant adviser in orthopedic surgery, Ministry of Health (knight bachelor); Paul Gordon Fildes, F.R.S., director of chemical bacteriology, Medical Research Council (knight bachelor); Archibald Montague Henry Gray, dermatologist, University College Hospital (knight bachelor); Prof. Ian Morris Heilbron, F.R.S., lately scientific adviser, Ministry of Production (knight bachelor); R. V. Jones, assistant director of intelligence (Science), Air Ministry (C.B.); A. K. Macbeth, Angus Professor of chemistry, University of Adelaide (C.M.G.); Frank Charles Mears, president, Royal Scottish Academy (knight bachelor); Edward James Salisbury, D.Sc., F.R.S., director, Royal Botanic Gardens, Kew (knight bachelor); Herbert Ray Stewart, vice-chairman, Imperial Council of Agricultural Research (knight bachelor); S. Zuckerman, scientific director, R.A.F. Bombing Analysis Unit (C.B.).

Announcements

A new interdepartmental acoustics laboratory has been established at Massachusetts Institute of Technology. The new laboratory is to be operated under the joint direction of the Institute's Departments of Physics and Electrical Engineering and the School of Architecture and Planning. It will collaborate with all departments interested in acoustic problems. Dr. Richard H. Bolt, assistant professor of physics, has been appointed director. He will work with a supervisory committee consisting of Profs. Philip M. Morse, Department of Physics, chairman of the committee; Richard D. Fay, Department of Electrical Engineering; Julius A. Stratton, director of the Research Laboratory of Electronics; and Lawrence B. Anderson, School of Architecture and Planning.

A five-year program of research has been laid out for the acoustics laboratory. One of the most important divisions of this program will deal with architectural acoustics, and the problems to be studied include the physical properties of acoustic materials and structures, as well as functional acoustic design. Special provisions will be made for such investigations by means of experimental full-scale rooms. Studies of special interest include sound absorption, distribution, and transmission in various types of structures.

A Laboratory of Nuclear Studies will be established at Cornell University for research in high-energy-particles phenomena, including cosmic rays. The laboratory is to be directed by Dr. Robert F. Bacher, who recently completed his work as head of the Bomb Physics Division at Los Alamos, New Mexico.

In making the announcement, President Day stated that the work of the laboratory would be coordinated with research in several divisions of the university, including chemistry, biological sciences, and engineering, in addition to the Department of Physics. According to Dr. R. C. Gibbs, chairman of the latter department, the new laboratory will become a part of a program of research in his department in which every member of the staff may participate.

Graduate appointments under the plan for coordination in the teaching of the sciences at Bryn Mawr College will be made this spring. Three scholarships of $600 each are offered to qualified students who have had undergraduate training in two or more of the natural sciences and who wish to continue study in one of the following fields: biochemistry, biophysics, crystallography, geochemistry, geophysics, or similar interrelated scientific fields.

Three fellowships of the value of $1,000 each are offered to candidates in the same fields who, in addition to undergraduate training, have had at least a year of graduate work in science. Special projects for 1946–1947 will include the study of oxidation-reduction potentials in microorganisms, phase rule studies of geologically important systems, and the investigation of molecular structure of organic compounds by X-ray methods.

The Committee will be glad to consider outlines of problems from applicants for these scholarships or fellowships. For application blanks, address Office of the Dean of the Graduate School, Bryn Mawr College, Bryn Mawr, Pennsylvania. No applications will be received after 15 March.

One of the most important records of earth motion in the history of seismology was obtained at the test of the atomic bomb in Jornada del Muerto (Journey of Death), New Mexico, on Monday, 16 July 1945, according to Dr. L. Don Leet, associate professor of geology at Harvard University, who spoke at the Harvard Club of Boston, Wednesday evening, 16 January 1946. As far back as 1904, experimental work led to computations of the wave patterns to be expected from a sharp, vertical impact on the ground. At the atomic bomb test, these conditions were duplicated experimentally for the first time with enough energy at the source to permit a thorough study under controlled conditions. The resultant observations differed widely and significantly from theoretical predictions. The most important feature was the fact that the greatest part of the energy was carried by two hitherto unknown wave types. One of these, the "Coupled Wave," was first observed and reported by Dr. Leet in 1939. Further work on the uses and importance of this wave was delayed by the war until it was found to be one of the dominant forms on the atomic bomb record. The other, the "Hydrodynamic Wave," had never before been reported. These two waves were held to be as fundamental to seismology as are atomic structures to nuclear physics.

A wide program of research embracing the new chemicophysical techniques has been announced by Dr. Edward R. Weidlein, director, Mellon Institute. This action is in accordance with the organization's aim of strengthening continually its investigational equipment and facilities. Dr. H. R. Klug, formerly in the Department of Chemistry, University of Minnesota, is in charge of this new activity of the Institute. There has been projected a department in chemical physics which will devote about half its time to service to the fellowships and the remainder to fundamental investigations of its own choice. The techniques included are X-ray diffraction, electron diffraction, electron microscopy, chemical microscopy, and the branches of spectroscopy.

A late-model Zeiss compound binocular research microscope was stolen from the Massachusetts General Hospital in Boston on 14 January 1946. The instrument has a slanting body, square stage, quadruple nosepiece, and was equipped with paired eyepieces and four objectives when stolen. The stand is No. 271,139; stage, No. 52,238; bitukni, No. 12,135; the Spencer 1b lens, No. 215,790 (brass); low-power Zeiss 8 X lens, No. 138,390 (chrome); high-power Zeiss 40 X lens, No. 153,567 (chrome); oil immersion lens, 90 X, No. 17,959 (brass). The owner, Dr. Richard Bennet Harvey, Massachusetts General Hospital, Boston, reports that the case was not taken.

The discovery of carbon 14 was announced early in January by Dr. J. Robert Oppenheimer, University of California, according to the *San Francisco Chronicle*. In explaining the difference between carbon 13 (*Science*, 1946, **103**, 82) and carbon 14, Dr. Oppenheimer explained that carbon 13 is a natural carbon isotope. About 1/70 of ordinary carbon is carbon 13. Carbon 14, on the other hand, is not a natural carbon, is radioactive, and is produced in conjunction with the cyclotron. The scientific use of the two carbons, Dr. Oppenheimer said, is approximately the same in principle, however. Carbon 14 was produced at the University by Dr. H. A. Barker, Dr. Martin D. Kamen, and Victoria Haas, a graduate student.

Carbon 14 was produced in a minute quantity by placing 1,000 pounds of ammonium nitrate near the 60-inch Berkeley cyclotron for 18 months. Since carbon 14 is radioactive, its use in biochemical tracer studies is expected.

Dr. Barker and his associates have been able to infuse carbon 14 into organic processes and point out that biochemical tracer studies with a radioactive isotope can be made easier than the more complicated mass spectrographic methods required in the case of carbon 13.

The Federation of American Scientists, 1621 K Street, N.W., Washington, D. C., has announced "complete agreement with the principles proclaimed in the President's letter and embodied in the McMahon Bill: (1) Full control over atomic energy developments in this country must be retained by the Federal Government in the interest of the nation as a whole. (2) This control must be exercised through a civilian government agency fully responsible to the President and Congress. (3) The development of science in this country must not be hamstrung by short-sighted and unrealistic policy based on the belief that military security can be achieved by imposition of secrecy in scientific research. (4) Most important of all, national legislation must not obstruct but smooth the path for the future creation of international control and inspection of atomic weapons—the only real chance of security in the age of atomic energy."

The announcement continues: "The McMahon Bill deserves the full support of all enlightened citizens. The control and development of atomic energy for the benefit of this nation and all mankind should not be permitted to become a partisan issue. If a civilian atomic energy authority is not established in the near future and the free flow of ideas and information between scientists in this country is not restored, the development of atomic science in America will suffer a grievous interruption, and chances for the elimination of the terrible danger of atomic warfare by an international settlement will be gravely endangered."

The statement was signed by: W. A. Higinbotham, president, and Melba Phillips, J. H. Rush, J. A. Simpson, Jr., L. N. Ridenour, and L. E. Schiff.

The American Academy of Arts and Sciences, at its January meeting, adopted a resolution endorsing United Nations Educational, Scientific and Cultural Organization (UNESCO) as a step toward "the peace of the world." Copies of the resolution were sent to the President, the Secretary of State, members of the American delegation to the UNESCO conference, and to learned bodies all over the world. The resolution follows:

> Believing that the peace of the world and the advancement of the arts, the sciences, and education in all countries can be effectively furthered by an active support of the United Nations Educational, Scientific and Cultural Organization, the Council of the American Academy of Arts and Sciences congratulates the Senate and House of Representatives of the Congress of the United States upon the several resolutions adopted by them favoring support of this organization, and urges upon the Congress the desirability of ratifying the charter of the organization on the basis of the signature of our representatives at the London Conference last November.
>
> In order that the widest support may be given to the United Nations Educational, Scientific and Cultural Organization, the Council desires that copies of this resolution shall be sent to all the learned and scientific bodies throughout the world with which it has communication, to the public press, to the President of the United States, the Secretary of State, the Speaker of the House, the President of the Senate, and to the Assistant Secretaries of State.

The U. S. Naval Academy is to hold examinations for positions in the Civilian Faculty on 19 and 20 April. The following positions are open: mechanical engineering, 2 assistant professors, 3 associate professors; physics, 2 instructors; electrical engineering, 1 instructor (power), 2 instructors (radio and electronic); mathematics, 13 instructors. Starting salary for instructors is $3,640, for assistant professors $3,860, and for associate professors $4,300. Application forms and notice of requirements may be obtained from the Superintendent, U. S. Naval Academy, Annapolis, Maryland. Application must be submitted prior to 15 March 1946.

Under a new plan the Navy will finance special research programs in universities. Essentially, the work will be done under a contract with the institution, and the colleges will be permitted to publish the results of the work providing no reference is made to possible or probable military application. Rear Admiral H. G. Bowen, chief of the Office of Research and Inventions, reported that the following institutions either already have completed contracts or are in the process of doing so: California Institute of Technology, Carnegie Institute of Technology, Columbia, Cornell, Brooklyn Polytechnic Institute, Harvard, Princeton, Johns Hopkins, Massachusetts Institute of Technology, University of Michigan, University of Pennsylvania, University of Texas, Syracuse, Stanford, University of California, University of Chicago, University of Illinois, Indiana University, Purdue, Pittsburgh, Southern California, Tufts, and Yale.

Ohio State University has established a graduate center for instruction and research at the Air Technical Service Command, Wright Field, Dayton, where graduate-level courses are being offered under the auspices of the Graduate School. The plan now involves more than 100 graduate students who are enrolled in the current winter quarter in mathematics, electrical engineering, and physics classes. Future development of the graduate center to include classes in aeronautical, communication, and power engineering, electronics, chemistry, management, and related technical subjects is planned, according to Dr. Alpheus W. Smith, dean of the Graduate School. "The integration of research and graduate teaching at the university with that of the Air Technical Service Command is of importance both to the University and the Air Technical Service Command. Such cooperation between the ATSC and campus scientists brings to the University a unique opportunity to be of service to the nation," Dean Smith said.

Over one hundred scientists affiliated with Johns Hopkins University, Johns Hopkins University Medical School, Johns Hopkins University School of Hygiene and Public Health, Carnegie Institute, Goucher College, University of Maryland Medical School, and the Maryland State Health Department have addressed a letter to President Truman, Senator Tydings, and others, endorsing the joint statement of Mr. Truman, Mr. Atlee, and Mr. King, "that a special commission of the United Nations Organization be created to set up enforceable safeguards against the use of atomic energy for destructive purposes, and that specialized information regarding the practical application of atomic energy be made freely available as soon as these safeguards are established."

The letter continues: "It is our conviction that the problems created by the atomic bomb urgently demand the promptest attention, and that it is the most solemn duty of every member of the Congress to insist that these problems be solved without undue delay. To this end, we hope that the governments of Great Britain, the Soviet Union, and the United States will be able to establish a temporary working agreement regarding the international control of atomic energy, as a basis for action on the matter by the United

Nations Organization. Should such an agreement be formulated by the representatives of these powers, we urge its careful scrutiny by the Congress, and if suitable, its prompt ratification."

Dr. Lise Meitner will deliver a course of lectures on nuclear physics at The Catholic University of America during the second semester, 1945–46. The lectures have been scheduled on Tuesdays and Thursdays, 5:10 – 6. A seminar on nuclear physics will be held on Fridays, 12 – 1. Scientists not wishing academic credit may attend as guests of the University without formalities.

In forty years, The New York Times points out editorially, "more than 20,000 voluntary health agencies have sprung up to deal with virtually every disease and health problem. It is a credit to philanthropy that it contributes annually not less than $100,000,000 to these agencies. There is no question that the work done is important and indispensable. But the Gunn-Platt report, which was made possible by a grant from the Rockefeller Foundation, raises questions. Would one large, well-supported organization be better than hundreds of local voluntary organizations? Are these many organizations efficiently directed? Are philanthropists getting their money's worth? The Gunn-Platt study of 569 voluntary and 143 official agencies reveals much that is good and much that calls for reform.

"There seems to be overspecialization in such fields as child welfare, tuberculosis, mental hygiene, infantile paralysis, to mention but a few. Too often four or five independent societies appeal for individual support instead of pooling their resources. There is a reluctance to keep pace with social change, a tendency to regard work in a special field as a vested interest, a lack of relationship between the size and importance of a health task and the money and services available for its performance. One energetic organization, for example, has in eight years raised $16,500,000 to cope with a disease which even in epidemic years accounts for less than 2,000 deaths. But heart diseases, to which 3,700,000 succumb annually, receives only three cents a case.

"Now that we have the Gunn-Platt report, the work of coordination must begin. To this end the Rockefeller Foundation has made a grant of $78,500, which will enable the National Health Council, a clearing house, to assume dynamic leadership in a movement which is bound to have its effect in improving the health of the country. There are to be joint planning, joint activities and joint services for national agencies, a strengthening of established health councils and an active field service to give practical counsel. The work to be undertaken by the National Health Council deserves support."

Wayne University College of Medicine invites applications for the Alexander Blain Hospital Fellowship in Anatomy for the year 1 July 1946 to 30 June 1947. This recently established fellowship is for research workers possessing either the Ph.D. or M.D. degrees and who are desirous of further experience in the broad fields of anatomy. Work is encouraged in gross anatomy, comparative anatomy, embryology, neuroanatomy, histology, and cytochemistry. The fellowship carries an annual stipend of $3,500, and the holder is assured of technical aid and funds for special equipment and supplies. Applications for the fellowship should be addressed to: Dean of the College of Medicine, Wayne University, 1512 St. Antoine Street, Detroit 26, Michigan.

The Marcelle Fleischmann Foundation has made a grant of $20,000 a year for a 10-year period to the Department of Public Health and Preventive Medicine of Cornell University Medical College for the study of tropical disease. The specified purpose of the gift is to promote the study of immunologic and allergic manifestations of exotic disease, and to provide for a better understanding of their prevention and treatment in relation to other allergic diseases. The investigations at Cornell will be under the direction of Dr. Morton C. Kahn.

Kirksville College of Osteopathy and Surgery has announced a research grant of $5,000 by the American Osteopathic Association.

The National Registry of Rare Chemicals, Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois, lists their need for the following chemicals: acrylic anhydride; acrylyl chloride; sodium phosphide; meta calcium phosphate, vitreous (25 lbs.); α-meta calcium phosphate (25 lbs.); cytochrome C; d- and l-gulose; d- and l-idose; l-ribose; l-lyxose; erbium (1 lb. or more); nitrogen trifluoride; sulfur hexafluoride; boron phosphate; pyocyanin, benzanthrone; hirudin; strychnidine; eleostearic acid; and pantoyl taurine. Please communicate regarding these directly with the Registry at the address given above.

Meetings

The 1946 spring meeting of the Crystallographic Society will be held at Smith College, Northampton, Massachusetts, on Thursday, Friday, and Saturday, 21–23 March. The sessions will be in Lilly Hall, Department of Physics. Those desiring accommodations on the Campus should write to the chairman of the local committee, Dr. Dorothy Wrinch, 81 Woodside, Amherst, Massachusetts. Additional accommodations are available at Northampton Hotel, Northampton. Further literature on arrangements may be had by writing to the Secretary of the Society, Dr. William Parrish, Box 39, Irvington, New York. The program follows:

Thursday, 3:00 P. M.—"Crystallography, a Common Ground in Many Sciences": I. Fankuchen, Brooklyn Polytechnic Institute; "The Lattice in Crystallography": J. D. H. Donnay, Johns Hopkins University; Late contributions; Tea, Department of Physics, Smith College. *Thursday,* 7:30 P. M.—"The Modifications of Silicon Carbide": N. W. Thibault, Norton Company; "Plastic Deformation and Recrystallization of Nonmetal Crystals": Edward Washken, Massachusetts Institute of Technology; Informal Hour, home of Prof. Benjamin M. Shaub, Department of Geology, Smith College. *Friday,* 9:30 A. M.—"Crystallographic Principles and Biological Problems": Dorothy Wrinch, Smith College; "Types of Order in Protein Fibrils": R. S. Bear, Massachusetts Institute of Technology; Late contributions. *Friday,* 2:30 P. M.—Business Meeting Crystallographic Society; Tea, Department of Physics, Smith College. *Friday,* 7:30 P. M.—"Optical Activity in Crystals; Crystallography of l-Cystine": C. D. West, Polaroid Corporation; "Experimental Study of the Change in Habit of Sodium Nitrate Crystals Grown From Water Solution": Howard T. Evans, Jr., Massachusetts Institute of Technology; "Variations in Crystal Habit of Pyrite in the Collins Hill Pegmatite Near Middletown, Connecticut": Benjamin M. Shaub, Smith College; "Twinning in Leadhillite": Samuel G. Gordon, The Academy of Natural Sciences of Philadelphia; Informal Hour, home of Prof. Gladys Anslow, chairman of the Department of Physics, Smith College. *Saturday,* 9:30 A. M.—"The Use of Sand in Making Fourier Projections of Crystal Structures": Dan McLachlan, Jr., and E. F. Champaygne, American Cyanamid Company; "Graphical Summation of Fourier Series in Crystal Structure Analysis": Joseph Lukesh, Massachusetts Institute of Technology; "Crystal Pattern Synthesis by an Approximate Summation of Fourier Series": Joseph Lukesh, Massachusetts Institute of Technology; Late contributions.

The Sixth Conference of the Institute of Food Technologists will be held on 18, 19, and 20 March at the Statler Hotel, Buffalo, New York. A total of 37 papers on the broad scope of food technology have been scheduled for the six technical sessions. In addition, an afternoon session consisting of eight papers is planned for those primarily interested in milk processing problems. Another afternoon session with a program of six papers is being devoted to frozen foods.

Elections

The New Hampshire Academy of Science held its twenty-fifth annual meeting at Hanover on 23 and 24 November 1945. The following officers were elected for 1945–1946: William W. Bowen, Dartmouth College, president; Donald Chapman, University of New Hampshire, vice-president; A. R. Hodgdon, University of New Hampshire, secretary-treasurer; and Roy P. Forster, Dartmouth College, member of the Council for four years.

The District of Columbia Chapter of the Society of Sigma Xi inducted three new members at the annual meeting held in the Cosmos Club on 29 January. Those honored and the subjects of their addresses were: Dr. Myron S. Anderson, senior chemist, U. S. Department of Agriculture, Beltsville, Maryland—"Nineteen Centuries of Soil Fertility"; Capt. Ernest W. Brown, USN (MC), Navy Department—"The Submarine: Certain Problems of Atmosphere"; Dr. John B. Reeside, Jr., chief, Paleontology and Stratigraphy, U. S. Geological Survey—"Why Study Fossils?"

The Shell Development Research Club, Emeryville, California, affiliated with the Society of the Sigma Xi, has announced its Council officers for 1946. These include: Harold T. Byck, chairman; William E. Vaughan, past chairman; Fred H. Stross, chairman-elect; Kenneth E. Marple, secretary; and Daniel B. Luten, treasurer.

Recent Deaths

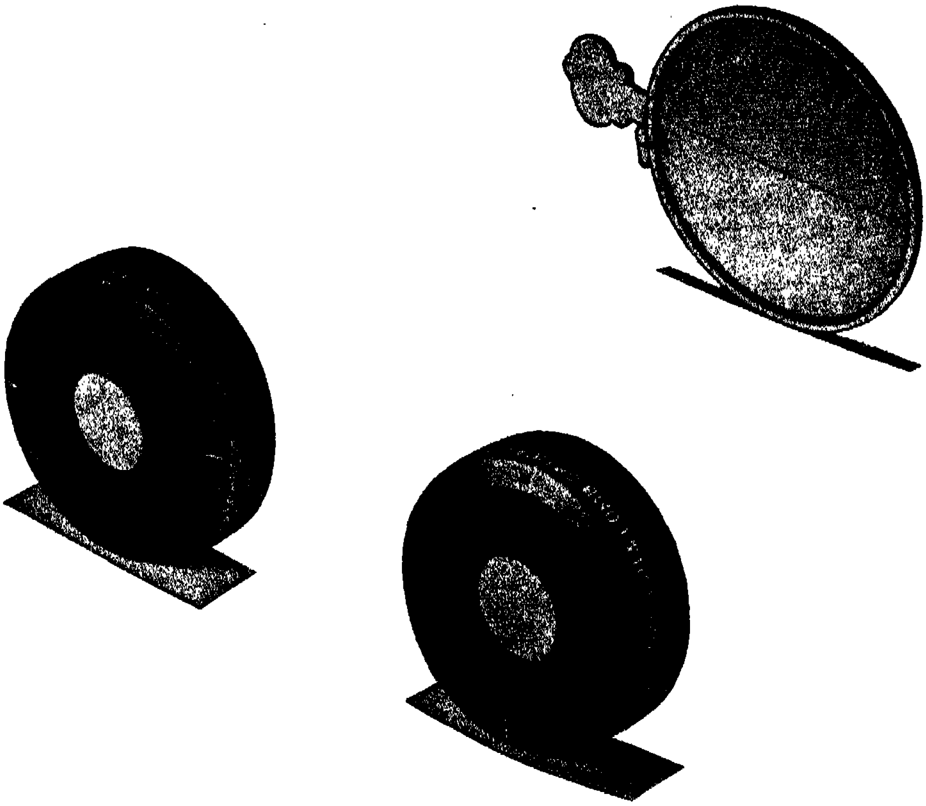
Dr. Otto Neurath, 63, died in Oxford, England, on 22 December. Dr. Neurath was the inventor of isotypes, the small symbols used to make statistical presentations less abstract. In the United States these symbols are more generally known a "pictographs."

Dr. Edward W. Koch, 64, dean of the University of Buffalo Medical School, died on 9 February.

Dr. Walter P. White, 78, retired Carnegie Institute physicist, died on 7 February.

Prof. Joseph M. Scott, 56, for 25 years professor of biology at Mount Union College, Alliance, Ohio, died on 1 February.

Dr. C. V. Taylor, 61, dean of the School of Biological Sciences at Stanford University, died in Palo Alto, California, on 22 February.



BAUSCH & LOMB STEREO-POLARIZER EQUIPMENT

The new Bausch & Lomb Stereo Polarizer makes possible a stereoscopic view of the object under examination with a standard monobjective binocular microscope. The Stereo Polarizer equipment consists of a substage polarizer and two eyepiece analyzers. The substage unit consists of a Polaroid disc cut in two with the polarization planes oriented at right angles to each other. The analyzers, fitted over each eyepiece, are oriented to correspond in vibration direction to either half of the condenser disc. As a result, the specimen is viewed by each eye from a different point of view . . . in three dimensional relief. In photomicrography it permits visual, stereoscopic examination of subject prior to making exposure. For complete information write Bausch & Lomb Optical Company, 642 St. Paul Street, Rochester 2, New York.

BAUSCH & LOMB

ESTABLISHED 1853

Letters to the Editor

Nuclear Energy and the Polar Icecap

Probably no scientific development has ever aroused as much discussion as that of atomic energy, or nuclear energy, which is a more descriptive title. This is properly so. It is inevitable that informed discussion should be accompanied by preposterous ideas, such as automobiles running on engines the size of one's fist supplied with nuclear power.

The statements that have been made recently by prominent people that with the advent of nuclear energy we are now in a position to melt the polar icecaps have evidently been put forth seriously, and have even caused concern in some quarters because of the threat of a general raising of the level of the oceans, the effect on weather conditions, etc.

On the bare possibility that some readers of *Science* have not bothered to go through the simple calculation that shows the absurdity of this proposal at the present stage of developments, it is presented herewith.

The icecap has been estimated to cover 5,000,000 square miles and to average 1,800 feet in thickness. To melt it from a temperature of – 40° F. would require 2.5×10^{23} B.T.U. of heat, which is equivalent to 3×10^{26} joules or 2×10^{45} electron volts of energy. This energy could be supplied as nuclear energy in two ways: by dropping bombs or by setting up so-called piles such as are used in the production of plutonium.

Each atom of U-235 releases about 2×10^{8} electron volts of energy. Operating at 100 per cent efficiency it would, therefore, require 10^{37} atoms or something over four billion tons of U-235 to do the job. At present costs of something over $10,000 per pound no comment is needed regarding the feasibility of this approach. The idea of using uranium piles is no more feasible. Surely a pile that dissipates 1,000,000 kilowatts would be considered a large one. The power output would be about equivalent to that of the Grand Coulee dam. With 10,000 such piles one could melt the icecap in about 1,000,000 years.

The foregoing remarks are not intended to detract in the slightest from the enormous possibilities that have been opened up by the introduction of nuclear energy. Those possibilities are surely great enough to tax the imagination of anyone to the limit and offer enough perplexing problems without introducing such ridiculous propositions as the one dealt with here.

RAYMOND T. ELLICKSON
Polytechnic Institute of Brooklyn

Transmission of Papaya Bunchy Top by a Leaf Hopper of the Genus *Empoasca*

A serious disease of papaya (*Carica papaya* L.), widely known under the name of "bunchy top," has been reported from different regions of the world where the plant grows. The disease is characterized during its initial stages by a faint mottling and chlorosis of its upper leaves, followed by a marked reduction and yellowing of the leaf lamina and a decided shortening of petioles and internodes, ending finally in a complete cessation of apical growth and bunchiness of the top which gives the disease its peculiar name. Another conspicuous symptom of the disease is the presence of hydrotic-like streaks, sometimes called "oil spots," along the stem and petioles.

Although long suspected to be a virus disease, nobody, as far as we know, has been able to transmit it either mechanically, by grafting, or through the aid of insect vectors. In 1937 J. H. Jensen (*Rep. Agric. Exp. Sta. Puerto Rico*, 1938, p. 125), working at the Federal Station at Mayaguez, Puerto Rico, found a leaf hopper, later described by Oman as *Empoasca papayae*, associated with papaya trees affected with bunchy top. His attempts to transmit the disease with this leaf hopper were inconclusive, however, as he had the misfortune of losing his experimental plants accidentally shortly before leaving the Station.

We have recently obtained evidence of the successful transmission of bunchy top with a leaf hopper of the genus *Empoasca* which, based on an examination of the male genitalia, we presume to be identical with the one used by Jensen. Seventy-one out of 90 healthy trees exposed to leaf hoppers collected on diseased plants began to show symptoms of bunchy top in about a month and a half. Most of the experiments were performed in insect-proof cages, but in some cases the insects were released inside cellophane casings inserted on the upper stem of the test plant after trimming the leaves. Unexposed controls (5 for every 10 plants exposed) remained healthy.

JOSÉ ADSUAR
Agricultural Experiment Station, Rio Piedras, P. R.

Geopathology, a Branch of Biometeorology

In his recent article on "Tropical diseases and geopathology" (*Science*, 1945, 102, 656) Dienaide stresses the fundamental importance of studying "the peculiarities of disease in relation to topography, climate and the distribution of pathogenic and disease-transmitting organisms," suggesting that "geopathology" be used to designate such a field of investigation. With this point I agree, but the author is in error when he states that (1) geopathology is in its infancy, (2) there are no geopathologic treatises even moderately comprehensive, and (3) our knowledge is fragmentary.

Although the fact is not widely known, geopathology is a branch of an already established science called biometeorology. Hippocrates knew of these problems when he wrote his *Airs, waters and places*, and Hirsch's and Drake's treatises on geopathology, published in the 1850's, are classics of medical literature. For many years, however, interest in these problems has been lacking, but along with the recent growth of interest in the problem of constitution, investigations of the influence of the environment on man have appeared in increasing numbers. In particular, workers both in this country and in Europe have been studying the influences of weather, climate, and altitude on plants and animals. This study has been designated biometeorology, and in 1939 a section devoted to the literature of this field was founded in *Biological Abstracts* under the section on Ecology. Some of the divisions of biometeorology are medical climatology, meteoropathology, geopathology, and climatotherapy. At the present time the Committee on Climatology of the American Geophysical Union is attempting a classification of the branches of biometeorology so that the existing and forthcoming literature will be readily available to the interested workers.

Although our knowledge is incomplete, it is certainly not fragmentary; for there is already available a vast literature on biometeorology. In recent years a number of excellent monographs have appeared, summarizing some of that knowledge. W. F. Petersen's *The patient and the weather* (4 vols., 1934–1938) and M. Piery's *Traité de climatologie: biologique et médicale* (3 vols., 1934) are among the most extensive. B. de Rudder's *Grundriss einer Meteorobiologie des Menschen* (1938) outlines many of the fundamental principles of the science. C. A. Mills' *Medical climatology* (1939) is an analysis of the seasonal and geographical variation of disease. A. G. Price has admirably analyzed the problem of the *White settlers in the tropics* (1939), and D. H. K. Lee (*Univ. Queensland Pap.*, 1940, 1, 1–86) has summarized the literature on the physiology of acclimatization.

I do, however, agree with Dieuaide that there is a great need for a systematic investigation of these problems, for a correlation of available literature to serve to focus attention on the problems requiring further study, and for collaboration among the interested investigators so that the research may be carefully planned and efficiently executed to reveal the facts and make the acquired knowledge applicable.

FREDERICK SARGENT, II, *Student*
Boston University School of Medicine

Retention of High School Science

When I read the recent comment of Charles A. Gramet concerning secondary school science courses (*Science*, 1946, 103, 149), I felt that a reply was necessary.

A few years ago I gave a college pretest in biology, at the time requesting that those who had studied the subject in high school indicate that fact. The results astonished me. Of some 50 students who had studied secondary school biology, only 10 ranked higher than

BACK IN STOCK

THE
Hormones
In Human Reproduction

by George W. Corner

SCIENCE: "A masterpiece. Even those of us who are intimately engaged in various aspects of the field of internal secretions are carried away with enthusiasm over Dr. Corner's skillful narrative of a detective story involving the innumerable facts accumulated during the past century by many inquisitive scientists. . . . Laymen, physicists, chemists, biochemists, and biologists alike will find this book exceptionally interesting and valuable."

ENDOCRINOLOGY: "A skillful refutation of the current concept that scientific writing, to be accurate, must also be dull. . . . Will be read by the biologist as an absorbing document of contemporary science."

JOURNAL OF THE A.M.A.: "One of the most delightful books that has come to the attention of the reviewer in many years."

CONTENTS

The place of the higher animals, and of mankind in particular, in the general scheme of animal reproduction. The human egg and the organs that make and care for it. The ovary as timepiece. The hormone of preparation and maturity. A hormone for gestation. The menstrual cycle. Endocrine arithmetic. The hormones in pregnancy. The male hormone. Chemical structure of the sex gland hormones.

**266 Pages, 56 illustrations,
Revised Printing, 1944, $2.75**

At your bookstore

PRINCETON
UNIVERSITY PRESS
Princeton, New Jersey

those who had none, and in no case was the increase in percentage more than 5 points.

Within the past 10 years I have taught in several high schools in widely separated places; I have also inspected numerous others. It has been my experience that the science teaching in most of these was very poor. Inadequate equipment, inadequately trained teachers, and, especially, administrative interference with classroom work accounted for this.

By interference is not meant meddlesome supervision, but the insistence that extracurricular nonsense be injected into study and class periods. In one school, for example, my chemistry class was interrupted daily by a loud-speaker broadcast of school gossip which (the school being small) was already familiar to the students, and this was by no means the only case.

College teachers have constantly to erase misconceptions acquired in the lower schools: One certainly becomes tired of hearing about ''pure and impure blood,'' ''nerves carrying messages,'' that ''spores are seeds,'' and that ''plants breath out oxygen.'' And although biology seems to suffer especially, similar misconceptions are numerous with respect to the other sciences.

One can agree most heartily with Mr. Gramet that we need to teach more science in the lower schools. But also needed are teachers meticulously careful not to instill wrong concepts. Poor results will continue as long as school boards insist that a music teacher give courses in biology and that the football coach teach physics. They will continue as long as textbooks, in order to simplify explanations, give wrong explanations. Especially will they continue as long as the ''pep meeting'' is so important that the entire business of the school is interrupted as a consequence.

The wonder is that children in high school learn anything at all.

CYRIL E. ABBOTT

Wesley Junior College, Dover, Delaware

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Summer camps and biological stations directory. Now that summer field work is again a possibility, biologists, botanists, geologists, and zoologists will want to secure a copy of the latest Turtox edition of *Biological field work.* This annual list of field stations and summer workshops lists the latest available information about such institutions that plan to have sessions this coming summer. The information also covers the type of course work offered, the name and address of the director, and the dates and expense of attendance. A special section, ''Afield With the Season,'' gives many valuable instructions for the best dates and ways to undertake collecting. *Biological field work, 1945–46 ed. SC–461.* General Biological Supply House, Inc., 761 East 69th Place, Chicago 37, Ill.

Apparatus for thermal conductivity method of gas analysis. Charles Engelhard, Inc., has published a large-size, 24-page bulletin describing the principles and operations of its equipment for gas analysis in production processes. Engelhard equipment is designed to use the principle that gases have certain thermal conductivities in relation to air which is taken as 1. These thermal conductivities vary widely and consequently offer a ready means of comparison between a standard gas and the gas to be analyzed. Equipment is available for the analyzing of SO_2, CO_2, H_2 and highly corrosive gases such as wet SO_2, H_2S, and Cl_2. *Bulletin 800 SC–463.* Charles Engelhard, Inc., 233 New Jersey R. R. Avenue, Newark, N. J.

Industrial research. Research directors and heads of laboratories who have a difficult and infrequent problem requiring specialized equipment and personnel will be interested in a recent brochure of the Arthur D. Little Company. A pioneer in the field of applied research, this company undertakes to do research on the fringe of a client's established activities; in many instances new fields are opened up and large investments in equipment and personnel are avoided. The brochure is illustrated with pictures of typical research problems. *Some information about Arthur D. Little, Inc. Brochure SC–463.* Arthur D. Little, Inc., 30 Memorial Drive, Cambridge, Mass.

Supplies for mineralogy and geology. Ward's Natural Science Establishment has issued a special catalogue covering its mineral rock and fossil collection materials. The catalogue is designed to assist both the instructor who is starting to build up a collection for classroom use and the advanced collector who is seeking special items. The mineral and rock section includes sections on introductory collections, collections illustrating descriptive and determinative mineralogy, petrographic and petrologic collections, and collections for general geology, dynamic and structural geology, and physical geography. The section on fossils presents material on introductory collections, study collections of fossil and recent plants, systematic collections, collections for use with Twenhofel and Schrock's paleontology, special stratigraphic collections, and general stratigraphic collections. *Catalogue 433 SC–463.* Ward's Natural Science Establishment, Inc., P. O. Box 24, Beechwood Station, Rochester 9, N. Y.

Biological leaflets. A new set of the *Turtox service leaflets,* published by the General Biological Supply House, has just reached this office. The series comprises approximately 50 informational pamphlets which have been prepared primarily for the use of biology teachers in secondary schools. The series is undergoing more or less constant revision and most of the pamphlets are rewritten and brought up to date once each year. Sample titles of several leaflets are: ''How to make an insect collection,'' ''Practical microscopy,'' and ''The culture of drosophila flies and their use in demonstrating Mendel's law of heredity.'' *Turtox service leaflets SC–468.* General Biological Supply House, Inc., 761 East 69th Place, Chicago 37, Ill.

SCIENCE

Vol. 103, No. 2672 Friday, March 15, 1946

The Millionth Map of Hispanic America

Isaiah Bowman

President, The Johns Hopkins University

THE MILLIONTH MAP OF HISPANIC AMERICA had its remoter origin in a personal experience of 1913 when, for the third time, I was preparing to go to South America on an expedition which had the good fortune to be sponsored by the American Geographical Society. My plans included a study of settlements on the margin of the pre-cordillera of northwestern Argentina and of the arid Puna de Atacama that marks the meeting place of Bolivia, Argentina, and Chile in the Central Andes. A base map for field notations was required and, though I searched the files of the principal collections in this country, I could find no map suited to the purpose. It was necessary to construct one, and a quick compilation was made to suffice. But in putting together the pieces of then-existing maps and in seeing on the ground the errors of earlier compilations, it seemed to me that a base map for all of Hispanic America was a first desideratum if we were to do serious geographic work in that vast territory in the years ahead and not waste the time of successive scholars, for the most part ill-equipped to do a

The desirability of a world map on a uniform scale **was first brought to official international attention in 1891 at the International Geographical Congress held at Berne, when Dr. Albrecht Penck, then professor of geography at the University of Vienna, urged the scale of 1:1,000,000. Resolutions were adopted confirming the appointment of an international committee to attain this objective. United States members on this committee were Major J. W. Powell, then director of the U. S. Geological Survey, and Dr. W. C. Mendenhall, then geologic aid in the Survey and later its director.**

The map was discussed at the International Geographical Congresses of 1899 and 1904, but no generally acceptable scheme of action could be found because of national loyalties—notably the reluctance of the British geographers to accept the metric system for the map and the insistence of the French geographers that its meridian of origin should be through Paris rather than through Greenwich.

Credit for bringing the discussions to a head, as well as for certain noteworthy contributions to the scheme of symbolization that was ultimately adopted, must go to Henry Gannett, the geographer of the U. S. Geological Survey, who exhibited a series of maps of states of the United States, showing relief by close contours in brown, at the International Geographical Congress held at Washington in 1904. This now-familiar convention contributed largely to the final decision to use this method of representing topography on the International Map rather than the hachures and hill shading favored by the Germans and French. Furthermore, his proposal of a 1:1,000,000 scale was unanimously accepted by the International Geographical Congress at Geneva in 1908 and led to the adoption of a series of resolutions dealing with the style, scale, and symbolism of the map.

To make these resolutions official, the British Government invited an International Map Committee to meet in London the following year. It is from the year 1909, when this meeting was held, that the International Map is generally dated.

The completion of the American Geographical Society's Map of Hispanic America, conforming in scale and style to the International Map of the World on the scale of 1:1,000,000—about 16 miles to an inch, was announced on 19 December 1945. The event was celebrated by a dinner for the Council at the Rainbow Room, Rockefeller Plaza, New York City, on that date. Dr. Bowman, who was director of the Society in 1920 when the work was started, spoke as recorded here. Mr. Spruille Braden, Assistant Secretary of State, whose long experience in South America forms a useful background for his remarks, spoke as recorded in part on pages 323–325.

The 107 sheets of the map cover all the land areas of the American continents from the Mexican-United States boundary to Cape Horn, including the West Indies, a total of about 8,000,000 square miles, or nearly one-sixth of the land surface of the globe. The task of producing the map has required the labor of an average of seven compilers, draftsmen, and editors working continuously for 25 years; the total cost of research, compilation and drafting, publication, and supplies has been nearly half a million dollars.

cartographic job expertly. Not only would the work of compilation of each cartographically untrained student be badly done—an amateurish compilation would be unsystematic and patchy and, in fact, unscientific and unscholarly—but there was also the question of how the job could be done for the whole of Hispanic America in one lifetime.

Two short years after my expedition of 1913 I became director of the American Geographical Society and found in its Council and members a spirit of enterprise that helped generate a feeling of happy accord with respect to future plans. The first World War interrupted these plans, but directly thereafter it was possible to launch a program of research in Hispanic America in which the Millionth Map played an important part. This is surely the place to say that there would have been no map and no Hispanic-American program of research if we had not had the support of Archer M. Huntington. Generous as his financial help has been, it is the lesser of his two gifts to this enterprise. His buoyant spirit is combined with a critical instinct and a scholarly approach. We have drawn liberally upon his intellectual strength. We are proud of the map, but we are equally proud of our association with him in an objective undertaking that has called out the best in the men engaged upon it.

In opening a program of Hispanic-American research I was anxious lest the quality and grand purposes of it be not fully understood. It would have been easier to choose a second-best plan, one of small scope, and coast to a near and undistinguished goal. A more austere point of view had to be taken. It would only make the plan and the Society second rate to concentrate energies and funds upon anything less good than the best. For is it not true that every time we consciously choose the second best our stature and our usefulness are diminished thereby? A first-class project inspires others also to reach for the stars, and though we all fail to touch them, the *effort* is what produces those powerful waves that wash the farthest shores of thought and action. A learned society can never be great through second-best performance or through mere advertising or by acquiring a large membership and revenues, but only through its generative or germinant power in men's minds. Thus, the American Geographical Society is not a building with collections and a staff at 156th Street and Broadway, New York, but an idea, a standard, and a wholesome force wherever men read its publications.

The scale of 1:1,000,000 is not what gives the map its peculiar distinction, but if one is going to do a map of Hispanic America, it is obviously wise to fit it into an existing scheme if this be possible without sacrificing quality and usefulness. I have heard it said of the Hispanic-American map that the millionth scale is not a new idea. This quite misses the point. It was deemed wise to advance the highly desirable Millionth Map of the world (agreed upon in 1909 by international action), while constructing a map of the particular area we had in view. It was the promotion of scholarly studies in Hispanic America on the part of students everywhere in the Western Hemisphere that was the grand objective, and the map was one instrument for such study. It was better to have it on the scale of 1:1,000,000 and thus secure the advantages of comparative studies as the world map on this scale advanced toward completion. I have used both the millionth sheets and the 1:500,000 compilations in the field and can testify that for most purposes they serve admirably. Photostatic enlargements of the source material used in the compilation, and available to any serious student at the Society, provide maps on scales that meet every need.

I hope that as time goes on and the number of source maps increases the millionth sheets will be constantly revised. Thus, a quality of endless growth would be introduced into the Hispanic-American program. Assuredly, the value of the source material will increase in time, and the Society will become, accordingly, a unique Western Hemisphere center for cartographic research. When Bancroft assembled his great collections in the field of Western history (now at the University of California), it was said that perhaps $250,000 went into the project. Today probably no library possessing it would sell it, but if it were to do so, its appraisal could hardly be under $10,000,000. The Society's great collection of source material is in this class, and in 50 or 100 years it will be a convenience and provide a stimulus to geographers second to no other like collection in the world.

The Millionth Map will bear comparison with the illuminated books of medieval time, for it was drawn by hand and is embellished with color. One important difference between the medieval book and the Millionth Map is that map printing has enabled us to reproduce in admirable color design the original drawings in thousands of copies, whereas each of the illuminated hand-drawn medieval books was unique. The lithographic art has been developed to the point which permits a very high standard of beauty to be coupled with mass production. Each sheet of the Millionth Map can be enjoyed for its aesthetic qualities. Indeed, these overshadow the utilitarian in my mind as I pick up each new sheet. While no printed book or map has the brilliance of an illuminated hand-drawn original, it can be said of the Millionth Map that it represents a level of beauty close to that of the medieval manuscript. This brief comparison is intended to link the map to a great tradition and a high point in human enterprise, supplying energy and artistic impulse to the dissemination of the word.

To me it has always seemed remarkable that members of the conference of representatives of many countries at London in 1909 should have had the good sense and good taste to devise standards of color, draftsmanship, and composition that have stood so well the test of the intervening years and that have been improved only in detail.

May I say a word about projections and the so-called new way of looking at the earth on an occasion that celebrates a map of conventional projection and design? One of the popular pastimes of the war period has been the construction of maps viewed from unusual angles and presented to us in popular style by devotees of the so-called "new cartography." Bizarre projections have certainly made a splash in the ocean of public interest. In so far as they have stimulated popular interest in maps, I suppose we can say that the effort has been well expended. But they have given the public some quite erroneous impressions of the broader purposes of maps. If one is accustomed to seeing Tibet on a map with the north at the top, it takes a mental wrench to see it with the south at the top. Since a mental stimulus is its own excuse for being, the new cartography has its place in education. A stereotyped view of a country is likely to become a dull view. We should *think* as men might who approach a country from any direction. I wish to point out, however, that this is only a convenience to a man who does not understand maps or read them readily. I wonder if a Gallup Poll would not show that those who have to have their orientations adjusted to the angle of their imaginative approach really are in a state of complete confusion when they have finished with their examination of the world, or parts of it, from strange and constantly changing angles of view. I am inclined to conclude this from my own experience with the public, but I hesitate to draw a wider generalization.

It is essential, in any case, that we have conventional maps that can be used for comparative purposes from country to country throughout the world. The Millionth Map represents a bold attempt to satisfy such a need. In a remarkably short space of time—indeed, in little more than a third of a century starting from scratch—we have had the greater part of the world represented on this scale. The Millionth Map of Hispanic America has taken a continent and a half out of a state of cartographic disorder into one of order, and thus it has so far advanced the world map that the urge to complete it is now higher than ever. The enterprise whose completion we celebrate tonight has been accomplished at a cost of a half million dollars, which is remarkably low when we consider that the highest craftsmanship, not the lowest, has marked its construction throughout. It is now possible readily to compute the cost of the unfinished portion of the map and plan for its completion.

We can all take pride in the fact that the map represents mutuality of interest among the geographers of the world and hardly less among scholars in other fields who use maps for comparative purposes—the historians, the archaeologists, the foresters, the anthropologists, and all those whose imagination is quickened, whose research instincts are affected, or whose teaching processes are promoted by drawing designs upon a base map that show where it is populated and where the heaviest or the lightest densities occur, whether of people, of forests, of minerals, or of agricultural production. Government today rests upon the adding machine as well as the electorate, the executives, the legislature, and the courts. Unless regular censuses are taken and the statistics analyzed, no government can deal intelligently with its people, its production, its internal social organization, its public health requirements, and its grander schemes of water control, whether for irrigation on the one hand or for drainage of excess water on the other.

To gather the statistics that are pertinent to national administration is one of the most important elements of intelligent government today. It is a part of the fact-gathering that Plato commended in describing his House of Wisdom. Unless a government is responsive to the principle so well stated by Bagehot, that "it is the business of government to evoke new power," it will find itself governing people of which it does not know the number or the distribution and shaping its administrative measures for peoples and environments for which it has not provided the means of analysis. From the beginnings of government ages ago it has been learned a thousand times that good government and good statistics are inseparable; and wise administration demands full statistics—full in the sense of meeting all the requirements of a country's social program, including the general development of human aptitudes and higher standards of living, two essential elements of an efficient national power plant.

Seen in this light, the Millionth Map is not merely a map to "glance at," as writers commonly say, and then to drop on the table. It is part of a great human experiment, creative and stimulating, whereby man is brought into rational relation with nature. The map happens to be a tool, however, that is different from any other in the experiment to which I am alluding. Compared with a book, it is expensive to make and it is useful almost in proportion as it covers a large extent of territory. The grander comprehensions of geographical science are over and above the meanings of the minute and local. The local must be studied for accurate detail, but the geographer is obliged also to bring the detailed parts into relationship if the realisms of human societies are to be understood. Indeed, this is his chief function. In doing so he must generalize, or his vocabulary becomes diffuse and his thought restricted to local neighborhoods. To bring the results of his work within the scope of government, industry, and national welfare, he must employ general descriptive terms for his analytical results—that is, he must identify types. In identifying and describing generalized types of human activity (cultural design and cultivation practices, for example), one must in a sense lose some of the detail. Only in this way can one see the grander features of a country, and surely only in this way can one develop a comprehensive view of the earth as a whole.

It was once said by a friend of mine that the geographer tries to bite off the world, but can he chew it? It takes long and hard study and an extremely keen appetite, as well as far-reaching curiosity and sustained eagerness of spirit, to carry a geographer to the point where he understands some of the major features of human relationships. In attaining this distant and high goal the maps and the statistical tables available are tools of the first importance. I like to think that the Hispanic-American map serves these great interests as well as the diverse disciplines of history and social science and geography. I like to think that it does so by its high standards of compilation, its faithful interpretation of available data, and finally, and not least, its aesthetic quality.

A significant feature of the Millionth sheets of Hispanic-America is the relative reliability diagram, introduced by the American Geographical Society. In 1928 I had the pleasure of sitting on an international committee on the Millionth Map which formally adopted the relative reliability diagram as a standard feature of the Millionth Map of the world. It is this diagram chiefly which distinguishes a scientific map. It tells how much we do not know and the degree of accuracy of that which we do know concerning the cartography of a given sheet. I hope the time will come when commercial maps will carry this feature, telling the reader the truth about the little we know concerning the less well-known parts of the world. The highest purpose of the relative reliability diagram, if I may put it paradoxically, is to lead to new surveys that will destroy the sheet upon which the diagram appears.

And now, having indulged me with respect to the hard core of purpose and use that marks the Millionth Map, will you let me take the lid of unemotional scientific control off my mind and indulge my imagination? The patch of color on the map of western Bolivia represents not merely marsh and water on the fringes of sheltered Lake Poopó, but also a vast flock of flamingoes which, in the soft light of sunset, give a shade of pink to the landscape. The rocky islets off the seacoast toward the northwest represent the tradition of one of the Indian romances of pre-Colombian days near the site of ancient Pachacamac. The caps of white that mark permanent snow are not mere meteorology, they are associated with the legendary gods of shore and mountain, fighting in deadly rivalry around the snowy peaks and storming at each other in the thunderheads that form on the flanks of the western cordillera. This trail does not represent the route of a modern pack train only; it represents Almagro marching into Chile.

The shores that front us represent the Spanish Main, and the blue is not merely a blue designed by Mr. Hoen, master engraver of Baltimore, who reproduced the drawings of the map. It is the primeval blue, the enchanting blue, of the Caribbean to which Lafcadio Hearn gave immortality. Dull the eye that cannot discern Orellano's rafts on the wide and muddy Amazon. There is a symbol on the map for Cartagena, but who can hear that name pronounced or see its letters on a map and not remember its walls and massive forts, the fighting and the jungle, and the storied enmity of Spaniard and Englishman? Not only Tehuelches and sheepherders but also Darwin and Hatcher have walked over those distant Patagonian plains. Freebooters, priests, and conquistadores should be sketched on all the borders of Hudson's Purple Land. In short, the map reflects human strife and greatness as well as a surveyor's drawings: we are in the presence not of first-class cartography alone but of great art and history.

The lines on the map, the colors and symbols, are visual representations of field measurements and contribute a systematically analyzed record of surveys reduced to a common scale. But they are more than this: they are inciters of the imagination that bathes all records with interest. Yonder island cape is no "sterile promontory" but the point of land around which de Quiros steered his little squadron as he set his course westward from Callao across the unknown Pacific, a venture hardly second to that of Columbus in boldness. The dark-brown color layers represent not merely a mountain chain but also an upthrust of the oldest sea-remembering rocks in South America. The green patch on the coast of northeastern Perú represents more than a marine terrace and a playa. Here the bird hosts gather at night, and we hear their cries and flutterings today precisely as they were heard by Pizarro's men as they staked out their cavalry in the chaparral on their first night ashore.

Besides its use in settling boundary disputes, the map has provided underpinning for field expeditions. It was in amazingly wide use in wartime and was ready for the emergency because the Society had the forethought to begin it long before the anticipated need arose.

I will not apologize for our interest in its use in wartime, however much we prefer the instruments and arts of peace. It is no small thing to contribute to success at arms when the objects in view are honor and freedom in a world that, only four short years ago, was all but lost to dishonor and slavery. It is through freedom tempered by discipline that the finest social gifts of civilization have come. Through freedom in America we have made a unique contribution to education, in the promotion of which this map and its large accessory activities have given direct impetus. Men who make contributions to freedom through the ages tend the eternal light of a universal humanity, and they ask no recognition except understanding, by those who come after, that their candles may be lit at the same altar.

If the Map of Hispanic America were not a part of all of these things, it would not have deserved 25 years of work by a devoted staff of compilers, draftsmen, cataloguers, and geographers, as well as collaborators and friends. Nor would it have justified the cost, for money abstracted from use today is money with a curse on it if it be not returned to human use tomorrow.

Congratulatory Address

Spruille Braden
Assistant Secretary of State, Washington, D.C.

WE DO NOT KNOW how the present efforts of government to cope with our daily problems may appear to future generations. Of this, however, I am certain: the completion of the Millionth Map, under the direction of the American Geographical Society, will in the long perspective be regarded as a great constructive achievement. Concluded in the midst of international chaos, it represents the indomitable determination of men to know and to master the world in which they live. It represents the forces of civilization advancing in spite of high barriers. It will stand as a permanent monument to the spirit of man. . . .

Having lived a good portion of my life among the peoples of the other American republics, for whom I acquired the deepest respect and affection, this map of their countries has a special meaning for me. Out of infinite detail honestly assembled and plotted, your Society has here set down a record of geographical realities. So those of us who have been privileged to dwell with the peoples of those countries have in our hearts and minds an appreciation of their rich culture and of their human values. For my part, I treasure the experience and am guided by it.

This Millionth Map, whose conclusion we are here to celebrate, represents a great cooperative undertaking. It is the product of active and constructive collaboration by scientific institutions, by government bureaus, by industrial organizations, and by individuals throughout the American republics. The moral is clear. Progress, the enlargement of knowledge, the achievement of human security, all call for the constructive and determined collaboration of nations, of organizations, of individuals everywhere. We do not live alone, and we cannot succeed alone.

Just as it is impossible for one man alone to make such a great map as this, so it is impossible for one single element in the nation alone to bring about relations of lasting friendship with the people of another nation. That, too, can come only from the countless threads of individual and collective association, woven together in an intimacy that brings warmth into human relationships.

That is the kind of foreign relations which we, the United States, desire to have. We cannot have it except as we respect ourselves and our obligations, at the same time respecting others and their rights in the same fashion that we expect them to respect us and our rights. We must seek to understand them as we hope they will understand us. We must never forget that intolerance begets intolerance, and that if we wish tolerance from others, we must first nourish it in ourselves. In these ways we shall gain friends and benefit ourselves by helping others. The guiding principle, in these matters, must always be reciprocity. That is the root of all friendship.

As a former mining engineer who has roamed in the Andes and through the jungles of South America, I can appreciate, not only the vastness of the cooperative undertaking represented by the Millionth Map, but the dangers that had to be faced in gathering the requisite information. You geographers will probably recall what Plutarch said of your far-distant predecessors—that they crowded into the outer edges of their maps the parts of the world about which they knew nothing, merely adding a note: "What lies beyond is sandy deserts full of wild beasts," or "blind marsh," or "Scythian cold," or "frozen sea." Now, in order to give the world the 107 sheets of this map, you geographers have adventured into "what lies beyond." At the cost of personal peril and hardship, you have gone out into the unknown and vanquished and charted it. I find no legendary deserts, "full of wild beasts," in the margins of *this* map!

I say I am not altogether unfamiliar with the kind of difficulties that confronted those who gathered the data for this map. To illustrate these from personal experience, I vividly recall one exploration camp, Sulfatos, 15,000 feet up in the Chilean Andes, where 31 years ago more than half of our 200 workers, my superintendent, and I were all snow-blind at the same time. We were beset by blizzards, snow slides, and every impediment possible to our work. Five of our men went insane in three months.

I know, too, that the hardships of the jungle are equally grêat. There are accounts of how an entire regiment was eaten up by the tropical forest, except for two men who finally emerged on the other side of the continent. Even today, in the Catatumbo Jungle of Colombia, there are wild Indians, the Motolones, hunting with bow and arrow, who every year attack and sometimes kill workers at oil-producing operations there—and this occurs, so to speak, just over the hill from modern cities displaying an advanced civilization. These conditions form part of the picture behind the 107 sheets and add glory to the achievement.

If I allow myself to speak from experience of the practical difficulties that were overcome, I think I can allow myself to speak with still greater assurance, from personal experience, of the practical consequences that must follow the making of this map. "Morality," said Herbert Spencer, "knows nothing of geographical boundaries." However that may be, practical statesmanship—as Dr. Bowman can well testify—is confronted by geographical boundaries at every turn of the road. During the three years of negotiating to put an end to warfare in the Chaco, one of the greatest obstacles we faced was the lack of any adequate maps. The most accurate of the maps on which we had to depend was as much as 60 kilometers out in some places. I recall the occasion when we mediators received from one of the parties to the dispute three or four maps we had not seen before. We mentioned this to the representative of the other party, who promptly replied: "Oh, if it's maps you want, I'll give you plenty." Within the week, we had received 150 maps, all of them different! In point of fact, the settlement in the Chaco was influenced by the natural features of the terrain, since we set the final boundary in such a way that 130 kilometers of desert, completely arid, would serve as a natural barrier to reinforce it.

The practical point I make here, however, is that, had accurate and authoritative maps been available in the past, one cause of international misunderstanding in this hemisphere might have been eliminated, thereby reducing loss of life and all the other horrors of warfare.

The lack of good maps has been behind many disputes in the Western World, although I am informed that there are still about a dozen instances in this hemisphere of boundaries that remain undelimited or at least undemarcated. This, thanks in great part to the geographers, is a rapidly disappearing cause of international differences.

Such differences breed fears and suspicions that are always likely to become exaggerated out of all proportion. If there is one thing I learned from the protracted negotiations of the Chaco settlement, it is that mutual fear and suspicion between contiguous countries, especially when their armies are facing each other at close quarters, make war all but inevitable.

The development of transportation and communications has now brought all the continents and countries of the earth into close quarters, facing one another, armed with weapons of hitherto unimagined range and destructive power. To ignore any source whatsoever of fear and suspicion, under such circumstances, would be to court catastrophe. Now the principal, I may almost say the universal, source of fear and suspicion is simple ignorance. Therefore, it is imperative that statesmen see to it that the vast areas of ignorance still existing in the world—the "sandy deserts full of wild beasts"—be transformed into areas of knowledge. They must plot every river and stream, every contour in the landscape of international relations. They must achieve detailed, accurate, and comprehensive knowledge based on the scientific approach exemplified by the cartographers. Responsibility for the spread of knowledge falls on every nation, but especially on such a power as the United States, with its vast resources.

We, the United States, are committed by our basic principles and by international agreements not to use our power to subvert human freedom or human rights anywhere. On the contrary, we must use all the influence that our power gives us to encourage human freedom and promote respect for the basic rights of man in the world. This attitude is nowhere more clearly illustrated than in our conduct under the Good Neighbor Policy and its corollary policy of nonintervention.

In respect particularly of the policy of nonintervention, we are and must be especially sensitive. No one will particularly fear the intervention of the small and the weak, but the very fact of great size and strength arouses fear of what might happen should we be tempted to resort to intervention. To illustrate how careful we must be, I quote the following pertinent statement by Mr. Sumner Welles, which occurs in his *The time for decision*: "The United States recognition," writes Mr. Welles, "of a new government which comes into being through extraconstitutional methods in some other American republic is generally interpreted in the rest of the hemisphere as an indication of approval of the policies and composition of the regime. There is consequently implicit in the act itself under existing conditions at least a suggestion of intervention."

It must be quite evident to anyone who has dealt with these problems that nonintervention cannot be negative either in concept or in practice. It is affirmative and positive by the very nature of things, since whatever we refrain from doing and whatever we refrain from saying may constitute intervention to the same degree as anything we actually do or say. We can dishonor our commitments to the cause of human freedom and to the principle of nonintervention equally by inaction as by action. If this were not so, then nonintervention would be a means for defeating the cause of freedom and encouraging the growth of tyranny. Surely this is not what is meant by nonintervention! I say we must be especially sensitive, in view of our great power, to our obligation of nonintervention. We must lean backwards. But we must lean backwards for the purpose of avoiding intervention by action and by inaction alike.

The problem we face is not how to avoid using our power. We cannot possibly avoid using it, for it weighs in the balance just as much even when we do not deliberately apply it or when we deliberately seek to avoid applying it. Not to use our power may be, in actuality, to *misuse* our power. The danger is equally great. To my mind the conclusion is inescapable that if a nation has great power, as we have it in abundance, it cannot shun the obligation to exercise commensurate leadership.

Leadership, exercised positively by us on behalf of human rights, is an obligation we must accept. Our own freedoms, our own way of life, our own democratic form of government, all depend on it. As you cartographers prepare your maps, scientifically and with infinite pains, so must our statesmen chart the course which leads to peace in the world, to human security, and to the permanent realization by mankind of its noblest aspirations. To do this, we must replace ignorance by knowledge. Whatever the difficulties and perils, we must prepare a millionth map of statesmanship to guide us in every field of international endeavor—social, economic, and political. In short, by emulating the splendid work of this great institution, the American Geographical Society, we can march forward to meet the future with confidence.

Scanning Science—

The suggestion has been made that in our large cities skiagraphic institutions should be erected and equipped, to which physicians or surgeons could send patients, and where, under their direction, pictures of the desired portion of the body could be prepared, just as a physician now writes a prescription which is sent to the druggist to be compounded. Our large hospitals where numerous accident cases are brought should have in the near future a plant sufficient to prepare skiagraphic reproductions at short notice.

Dr. Selle and Dr. Neuhauss have exhibited in Berlin colored photographs which have attracted much attention. They are said to be taken by the method used by Mr. Joly of Dublin, three specially prepared plates appropriate for green, red and blue lights respectively being used. The process has been simplified and the time of exposure shortened. Mr. Frederick Ives exhibited before the Royal Photographic Society of London, on February 25th, his stereopticon showing colored pictures.

—6 March 1896

Technical Papers

Deposition of Calcium Phosphates Accompanying Senile Degeneration and Disease

CLIFFORD FRONDEL
Harvard University
and
EDWIN L. PRIEN
Newton-Wellesley Hospital,
Newton, Massachusetts

The substance of certain pathological calcareous concretions or plaques variously found in the lachrymal duct, prostate gland, and the walls of bronchial tubes and arteries has been loosely described as "phosphate and carbonate of lime," "earth of bones," "earthy phosphate mixed with carbonate of lime," and, more generally, simply as calcium phosphate, ever since the time of the first description by Wollaston in 1797. The question whether the carbon dioxide found on the chemical analysis of such materials is present as admixed carbonate or as an integral part of a single phase has been uncertain. Investigations in recent years by X-ray diffraction and optical methods have failed to show admixed calcium carbonate and phosphate in bone and teeth, however, and it is now generally held that these deposits consist of a substance with an apatite-type structure that contains constitutive carbonate ion. It may be noted that tricalcium phosphate hydrate, $Ca_3(PO_4)_2 \cdot nH_2O$, gives an X-ray powder diffraction pattern similar to that of apatite and is isomorphous therewith. Carbonate can enter this compound, as in apatite. The material can be distinguished (*2*) from hydroxylapatite, $Ca_{10}(PO_4)_6(OH)_2$, by heating to *ca.* 900° C., where it breaks down to β-$Ca_3(PO_4)_2$, whitlockite, and then gives the X-ray pattern of that substance. On the other hand, apatite, specifically including carbonate-apatite, and whitlockite give an unchanged pattern after such treatment.

By chemical, optical, and X-ray studies we have identified carbonate-apatite as the principal inorganic salt in the pathological calcification of tuberculous lymph nodes and subcutaneous hematomata. A concretion obtained from a chronically infected prostate gland was found to be composed of fine-grained carbonate-apatite together with crystals of struvite, $NH_4MgPO_4 \cdot 6H_2O$, and an unidentified substance. Brushite, $CaHPO_4 \cdot 2H_2O$, also has been reported in prostatic deposits. Calculi removed surgically from the sublingual salivary glands in several patients were identified as carbonate-apatite. We have also found that the common plaques developed in arteriosclerosis of the aorta and other large arteries, composed largely of cholesterol, frequently contain a small amount of carbonate-apatite. The occurrence of an apatite-like substance was earlier noted by Saupe and Klötzer (*5*) in aortal concretions and by Huggins and Bear (*4*) in prostatic calculi. The "calcium phosphate and carbonate" reported in tonsillar and pancreatic calcifications probably is carbonate-apatite. The latter has also been reported as a common constituent of calculi in the kidneys and urinary bladder by Frondel and Prien (*1*).

A variety of whitlockite containing a small amount of carbonate and analogous to carbonate-apatite was identified as composing a small pathological calcification of the appendix testis or hydatid of Morgagni. This substance also has been found as calculi in the urinary tract. We have not found tricalcium phosphate hydrate in any pathological calcification so far examined, although Hendricks and Hill (*3*) point out that the available evidence indicates that it is the principal constituent of bone.

References

1. FRONDEL, C., and PRIEN, E. L. *Science*, 1942, **96**, 431.
2. HENDRICKS, S. B., *et al.* *Ind. eng. Chem.*, 1931, **23**, 1413; MACINTIRE, W. H., *et al.* *Ind. eng. Chem.*, 1945, **37**, 164.
3. HENDRICKS, S. B., and HILL, W. L. *Science*, 1942, **96**, 255.
4. HUGGINS, C., and BEAR, R. S. *J. Urol.*, 1944, **51**, 37.
5. SAUPE, E., and KLÖTZER, F. *Fortschr. Geb. Rontgenstr.*, 1933, **47**, 852.

Rate of Enzymic Digestion of Proteins as a Factor in Nutrition[1]

DANIEL MELNICK, BERNARD L. OSER, and
SIDNEY WEISS
Food Research Laboratories, Inc., Long Island City,
New York

The principal factors which determine the value of a food as a source of protein are (1) its protein content in relation to total solids, (2) the essential amino acid composition of the protein, and (3) the availability of these essential amino acids for tissue protein anabolism. It has been found (*5*) in studies with protein hydrolysates that the omission of a single essential amino acid from an otherwise adequate mixture results in poor utilization of the absorbed amino acids. If the missing amino acid is injected separately eight hours after the basic mixture is administered, the retention of amino acid nitrogen is not improved. The working hypothesis in the present study states that for optimum utilization of food proteins all essential amino acids must not only be available for absorption but must also be liberated during digestion *in vivo* at rates permitting mutual supplementation.

---

[1] The material in this report constitutes part of a paper presented by one of us (B.L.O.) before the Section on Food and Nutrition, Gibson Island Conference of the American Association for the Advancement of Science, July, 1945.

Of the various methods for biologically estimating the nutritive value of proteins, one of the best is the nitrogen balance method of Mitchell (*11*). This procedure demonstrates, but does not explain, why a given protein may show differences in biological value after heat treatment even though its ultimate amino acid composition and degree of digestibility remain unchanged. By supplementing the bio-assay technic with the *in vitro* digestibility procedure described in this report, the probable basis for this phenomenon can be elucidated.

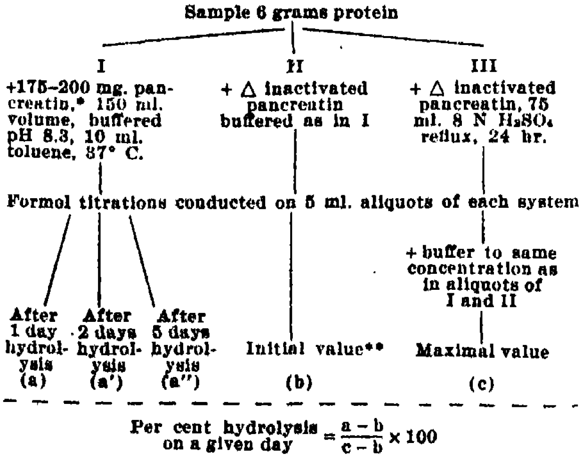

Sample 6 grams protein
I
+175–200 mg. pancreatin,* 150 ml. volume, buffered pH 8.3, 10 ml. toluene, 37° C.
II
+ Δ inactivated pancreatin buffered as in I
III
+ Δ inactivated pancreatin, 75 ml. 8 N H₂SO₄ reflux, 24 hr.
Formol titrations conducted on 5 ml. aliquots of each system
+ buffer to same concentration as in aliquots of I and II
After 1 day hydrolysis (a)
After 2 days hydrolysis (a')
After 5 days hydrolysis (a'')
Initial value** (b)
Maximal value (c)
Per cent hydrolysis on a given day = (a − b)/(c − b) × 100

FIG. 1. *In vitro* technic for estimating susceptibility of proteins to enzymic digestion.

* Quantity of U.S.P. pancreatin dependent upon potency of preparation.

** Includes the titration of the free amino groups in the intact proteins plus the titration of the buffer.

The *in vitro* method involves periodic measurements of the degree of hydrolysis of the protein by a modified formol titration procedure. The details of the method are presented in Fig. 1. The use of suboptimal quantities of pancreatin permits digestion to proceed for several days at 37° C., thus retarding the liberation of the amino acids to reveal differences in rate of digestibility.

Details of the formol titration conditions will be reported elsewhere. Suffice it to say that the titrations were terminated at pH 9.5, instead of pH 8 to 9, yielding values for formol titratable nitrogen in closer agreement with total nitrogen; pancreatic activity was standardized; naturally present enzymes were inactivated and bacterial action prevented; and finally, amide nitrogen and fat were not interfering factors under the conditions employed.

Correlation of the results obtained by this empirical *in vitro* test with more than 30 biological assays of five different sources of food protein has emphasized the value of supplementing the biological data with evidence on the susceptibility of these proteins to enzymic digestion. The animal experiments involved both nitrogen balance studies with the rat and growth studies with both the rat and the chick.

Soybean protein is especially suited to the study of the above-stated hypothesis, since it shows no change in amino acid composition or in degree of digestibility before and after various types of processing, but exhibits marked differences in biological value (retention of absorbed nitrogen).

The data in Table 1 show that those factors known (*12*) to increase the nutritive value of the soy protein also affect the susceptibility of the protein to enzymic digestion. Dry heating of soy flour at 100° C. at atmospheric pressure, or heating the meal in boiling water, induces no improvement in the biological value of its protein. However, autoclaving causes a pronounced increase. It will be noted that with more effective autoclaving treatments the susceptibility of the soy protein to enzymic digestion increased progressively until a plateau in values was reached. Improvement in biological value due to the method of manufacturing soy grits was evidenced by the greater degree and rate of digestibility of the original material.

TABLE 1

SUSCEPTIBILITY OF SOY PROTEINS TO ENZYMIC DIGESTION

Sample (protein content)	Laboratory processing	Hydrolysis of proteins		
		After 1 day	After 2 days	After 5 days
		Per cent		
Solvent-processed soy flour (52.7%)	None	8	9	11
	100° C., 7 days, atmospheric pressure	8	9	11
	In water, 100° C., 5 min.	7	9	11
	Autoclaved 10 min. at 5 lbs. pressure	9	10	14
	Autoclaved 10 min. at 10 lbs. pressure	12	21	24
	Autoclaved 30 min. at 10 lbs. pressure	14	23	29
Expeller-processed soy grits (48.7%)	None	16	20	24
	Autoclaved 10 min. at 10 lbs. pressure	20	23	29
	Autoclaved 30 min. at 10 lbs. pressure	22	27	33
	Autoclaved 30 min. at 15 lbs. pressure	18	25	34
	Autoclaved 45 min. at 15 lbs. pressure	16	25	33

Almquist and collaborators (*2*) and Hayward and Hafner (*8*) demonstrated that the limiting amino acid in soy protein is methionine and that heating under pressure increases the availability of this amino acid. The fact that it is the rate rather than the extent of liberation of the methionine in soy protein which determines the biological value of soy protein is evident from the illustrative data in Table 2. Using the nitrogen balance technic described by Mitchell (*11*), it was found that the protein in the raw soy had a biological value of 53 per cent as compared with the value of 71 per cent for the heat-processed soy meal.[2] The coefficients of digestibility of the proteins were approximately the same, 81 and 84 per cent, respectively. Calculations based upon the methionine (*1, 10*) intake, the metabolic fecal excretion of the amino acid, and the total fecal methionine excretion indicated that in both cases approximately one-half of the dietary methionine was not absorbed from the gastrointestinal tract. This constitutes a specific case where degree of digestibility of the protein in the gastrointestinal tract as well as the extent of absorption of the limiting amino acid, methionine, are unchanged, but, nevertheless, the biological value (retention of absorbed nitrogen) varies considerably.

TABLE 2

RATE OF ENZYMIC LIBERATION OF AMINO ACIDS DURING THE *in Vitro* TEST OF PROTEIN DIGESTIBILITY AS A CRITICAL FACTOR IN DETERMINING NUTRITIONAL RESPONSE

Experiment	Raw soy meal	Processed soy meal
Rat assays		
Biological value of the proteins, per cent	53	71
Coefficient of digestibility of the proteins, per cent	81	84
Dietary methionine unabsorbed, per cent	49	47
In vitro enzymic hydrolysis of proteins (a)		
After 1 day, per cent	11	14
After 2 days, per cent	16	25
After 5 days, per cent	22	37
Amino acid composition of the proteins (b)		
Leucine, per cent	7.1	7.7
Lysine, per cent	5.1	5.4
Methionine, per cent	2.2	2.2
Liberation of amino acids (c)		
Leucine } per cent, after 1 day hydrolysis	28	33
Lysine	45	56
Methionine	5	10
Leucine } per cent, after 5 days hydrolysis	52	65
Lysine	77	84
Methionine	36	73

(a) Based upon liberation of free amino groups, as determined by formol titration.

(b) Analyses on acid hydrolyzed samples, values calculated to 16 per cent nitrogen.

(c) Includes not only free amino acids but also peptides, liberated during the *in vitro* enzymic hydrolysis and not precipitated by 7 per cent trichloroacetic acid. The values listed are percentages of the total.

The *in vitro* digestibility tests indicated a marked difference in the susceptibility of these proteins to enzymic digestion. This would indicate that during digestion *in vivo* the methionine is released earlier from the heat-processed soy meal than from the raw soy meal. Eventually the same amount of methionine is released and absorbed from either product. However, in the case of the raw meal, absorption occurs so late in the intestinal transit that this amino acid, as well as the incompletely supplemented amino acids, are not efficiently utilized for the synthesis of body protein.

The validity of this interpretation is supported by further experimental findings. The proteins of the raw and processed samples were analyzed for three amino acids, leucine,[3] lysine (*4*), and methionine (*1, 10*). Practically the same values were obtained for both products, in agreement with the values reported in the literature for soy protein (*3*). The deproteinized filtrates obtained in the course of the *in vitro* enzymic hydrolysis of protein, at the end of the first and fifth days, were also subjected to amino acid analysis. The values for leucine, lysine, and methionine in the digests include these amino acids not only in the free state but also in peptide linkage not precipitated by 7 per cent trichloroacetic acid. Hence, the percentage amino acids in the filtrates of the protein digests should be considerably greater than that estimated by formol titration which measures only free amino groups. It may be noted (see Table 2) that methionine was liberated very slowly from raw soy as compared with leucine, while lysine was most rapidly released. In the case of the processed soy the same relationship held, although all amino acids were liberated at somewhat faster rates. When the five-day digests were tested, it was found that most of the lysine and more than half of the leucine had been released. The digest of the heat-processed soy meal contained twice as much methionine as that of the raw meal. These data indicate that methionine is liberated at a slower rate than the leucine or lysine in soy protein and that heat processing increases the rate of liberation of the methionine to a relatively greater extent.

This concept of rate of liberation of methionine supports observations made by others in studies with soy protein. Johnson, Parsons, and Steenbock (*9*) have reported negligible decreases in fecal sulfur and nitrogen when raw soy meal is replaced with a properly cooked product. However, greater retention (decreased urinary excretions) of both these factors was noted when the heat-processed soy meal was fed. These observations are in complete harmony with the hypothesis presented in this report, since they, too, indicate no increase in methionine absorption when the heated soy is ingested but, under such circumstances, better utilization of this as well as the other amino acids. More recently, Evans (*6*) reported no correlation between the "digestible" organic sulfur content of soy protein and its nutritional value.

---

[2] The proteins were included in the diet to the extent of 9 per cent of the ration. Adult male rats were employed for the assays.

[3] Composite of the methods of S. Shankman, *J. Biol. Chem.*, 1943, 150, 305; and J. R. McMahan and E. E. Snell, *J. Biol. Chem.*, 1944, 152, 83.

The present studies, conducted with soy protein, have been extended to oats, milk, and other proteins and have yielded similar data indicating that the rate of release of individual amino acids during enzymic digestion can readily account for differences in the biological value of the proteins. However, some precautions must be exercised before rating a sample with maximal digestibility as the most acceptable. For example, excessive heat processing of soybean meal can lead to destruction of some amino acids, so that the biological value becomes the resultant of two factors: (1) the improved digestibility of the protein, leading to greater retention of the absorbed nitrogen, and (2) the imbalance in essential amino acid composition, responsible for a lowering of the biological value of the protein.

On the basis of the present findings it might seem that protein hydrolysates should be superior in biological value to the original intact proteins. In the case of the former, the amino acids would be liberated *in vivo* very rapidly and therefore be available for absorption almost as a group. However, the recent report by Woolley (*13*) indicates that there may be one or more essential peptides which the animal organism is unable to synthesize. It was found that the omission of the factor, strepogenin (presumably a peptide), from a dietary containing a hydrolysate which furnished all of the essential amino acids in satisfactory quantities was responsible for the poor biological response. Thus, in addition to a proper balance of the essential amino acids, it may be necessary to insure certain peptide linkages in the dietary for satisfactory utilization of amino acid nitrogen.

Addendum: The report by Ham and associates (*7*), which appeared while this paper was in press, suggests that the effect of heat on a proteolytic inhibitor in soybean is responsible for the differences in susceptibility of soy protein to enzymic digestion. However, the impairment in utilization of the protein derived from raw or improperly heat-processed meals must be attributed to an inhibition of the *rate* of methionine liberation for mutual amino acid supplementation and not to a reduced *degree* of methionine availability as postulated by Ham and collaborators.

References

1. Albanese, A. A., Frankston, J. E., and Irby, V. *J. biol. Chem.*, 1944, 156, 293.
2. Almquist, H. J., Macchi, E., Kratzer, F. H., and Grau, C. R. *J. Nutrition*, 1942, 24, 385.
3. Block, R. J., and Bolling, D. *The amino acid composition of proteins and foods.* Springfield, Ill.: Charles C. Thomas, 1945; and personal communications from Dr. R. J. Block.
4. Dunn, M. S., Camien, M. N., Shankman, S., Frankl, W., and Rockland, L. B. *J. biol. Chem.*, 1944, 156, 715.
5. Elman, R. *Proc. Soc. exp. Biol. Med.*, 1939, 40, 484.
6. Evans, R. J. *Arch. Biochem.*, 1945, 7, 33.
7. Ham, W. E., Sandstedt, R. M., and Mussehl, F. E. *J. biol. Chem.*, 1945, 161, 635.
8. Hayward, J. W., and Hafner, F. H. *Poultry Sci.*, 1941, 20, 139.
9. Johnson, L. M., Parsons, H. T., and Steenbock, H. *J. Nutrition*, 1939, 18, 423.
10. McCarthy, T. E., and Sullivan, M. X. *J. biol. Chem.*, 1941, 141, 871.
11. Mitchell, H. H. *Ind. eng. Chem.* (Anal. ed.), 1944, 16, 696.
12. Payne, D. S., and Stuart, L. S. *Soybean protein in human nutrition: advances in protein chemistry.* (M. L. Anson and J. T. Edsall, Eds.) New York: Academic Press, 1944.
13. Woolley, D. W. *J. biol. Chem.*, 1945, 159, 753.

A "Frenching" Response of Tobacco Seedlings to Isoleucine

Robert A. Steinberg

Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Maryland

Growth of tobacco seedlings in aseptic cultures under constant light and temperature was found to be greatly modified by the presence of isoleucine in the culture medium. The abnormalities in gross morphology resulting from the addition of this amino acid consisted in loss of dominance of the apical bud, production of numerous quite narrow leaves, and mottled chloroses. The shortened stem and excessive development of axillary buds gave a "witch's broom" type of growth. The abnormalities enumerated are characteristic of a tobacco disease called frenching, the cause of which is unknown.

Slight variations from the symptoms of frenching in the field were observable under the extreme environmental conditions employed. These abnormal conditions were very high moisture and relative humidity, low light intensity, and the use of agar instead of soil. The mottling of the leaves was not of the reticular pattern typical of frenching, nor did the narrow or strap-leaves assume the upright position to the same degree. There was little indication of wavy margins or ruffling of strap-leaves.

These abnormalities occurred regularly in every experiment with several samples of this amino acid. None of the other amino acids, sugars, vitamins, and peptones (a total of 60) tested brought about this reaction. The severity of abnormal symptoms varied with the concentration of isoleucine employed. Levels of 50 to 200 p.p.m. proved adequate under these conditions. Complete details of the experimental work will be reported later.

Additional work is now under way in both greenhouse and field to determine the degree in identity of symptoms under normal conditions of growth for tobacco. Data are also being sought to aid in determining whether the response of the tobacco plant to isoleucine is of a primary or secondary nature. Secondary causatives of this type have already been reported by McMurtrey (*1*) as thallium and Spencer (*2*) as sulfanilamide.

References

1. McMurtrey, J. E., Jr. *Science*, 1932, **76**, 86.
2. Spencer, E. L. *Amer. J. Bot.*, 1939, **26**, 14 S.

On the Specificity of Epidemic and Murine Typhus

Vincent Groupé and Richard Donovick[1]

The Biological and Chemical Laboratories

E. R. Squibb and Sons, New Brunswick, New Jersey

That the rickettsiae of epidemic and murine typhus are closely related antigenically is shown by the fact that infection of guinea pigs with epidemic typhus confers complete immunity to infection with murine typhus and vice versa. That they are, however, not antigenically identical has been shown by the following observations: (a) Immunity induced with one inoculation of killed murine rickettsiae protected guinea pigs only against infection with the homologous type, although repeated inoculations of the same vaccine also immunized against the heterologous type (*7*). (b) Serum obtained from a horse after one series of inoculations with killed murine rickettsiae protected guinea pigs only against infection with the homologous type (*8*) although serum from the same horse after a second series of inoculations with the murine vaccine protected guinea pigs against both homologous and heterologous types (*9*). (c) Purified rickettsial suspensions reacted in complement-fixation tests only with homologous convalescent human and guinea pig sera, although the corresponding "soluble antigens" reacted with both homologous and heterologous sera (*5*). (d) Absorption of sera from cases of Brill's disease with murine antigen removed murine but not epidemic antibody, although epidemic antigen removed both murine and epidemic antibody (*4*). (e) Sera obtained from guinea pigs immunized with murine and epidemic typhus vaccine, respectively, neutralized only the homologous toxic substance (*6*).

The specificity of epidemic and murine typhus has been further demonstrated by the active immunization of mice in the experiments described below. Murine (Wilmington strain) and epidemic (Breinl strain) typhus vaccines were prepared from heavily infected yolk sacs[2] and two groups of 50 mice[3] each were immunized with one intraperitoneal inoculation of 0.5 cc. of epidemic and murine vaccine, respectively. Fourteen days after inoculation half of each group of immunized mice was challenged with homologous and the remainder with heterologous toxic substance (*1, 3*). The challenge dose, consisting in each case of 0.5 cc. of toxic substance, representing 3 to 4 LD_{50}, was injected intravenously in the tail vein. The results, recorded 18 hours after challenge, are presented in Table 1. It will be seen that 20 of 23 mice immunized with epidemic typhus vaccine and 22 of 23 mice immunized with murine typhus vaccine were protected against 3 to 4 LD_{50} of the homologous toxic substance. Furthermore, none of 23 mice immunized with murine typhus vaccine and only one of 23 mice immunized with epidemic typhus vaccine was protected against the heterologous toxic substance. It is evident from these data that one inoculation of epidemic or murine typhus vaccine protected mice only against the homologous toxic substance.

TABLE 1

Specificity Shown by Active Immunization of Mice

Challenged I.V. with 0.5 cc. of:	Vaccinated I.P. with 0.5 cc. of:		Controls	
	Epidemic typhus vaccine	Murine typhus vaccine	Toxic substance diluted:	
			1–20	1–40
Epidemic toxic substance diluted 1–10 (3 to 4 LD_{50})	20/23*	0/23	0/10	8/10
Murine toxic substance diluted 1–10 (3 to 4 LD_{50})	1/23	22/23	0/11	7/10

* Number of mice surviving/total number of mice.
I.V.—Intravenously.
I.P.—Intraperitoneally.

Summary: The specificity of epidemic and murine typhus has been shown by active immunization of mice with killed rickettsial suspensions and subsequent challenge with heterologous and homologous toxic substance.

During the preparation of this manuscript, Fitzpatrick published findings showing that 3 of 8 mice immunized with murine typhus vaccine were protected against 3 MLD of epidemic toxic substance administered intravenously and that 8 of 16 mice immunized with epidemic vaccine were protected against < 1 MLD of murine typhus rickettsiae administered intraperitoneally (*2*). These results suggested to Fitzpatrick that the toxic factor in the two strains is identical. Although there are antigens common to both strains, our findings do not support the suggestion that the two toxic substances are identical.

---

[1] On temporary leave from the Division of Microbiology, Squibb Institute for Medical Research.

[2] National Institute of Health, Washington, D. C. Communication on the preparation of epidemic typhus vaccine, 10 August 1942 (confidential).

[3] Young albino Swiss mice (Webster strain) weighing 12–18 grams were used throughout these experiments.

References

1. Bengtson, I. A., Topping, N. H., and Henderson, R. G. Withheld from publication.
2. Fitzpatrick, F. K. *Proc. Soc. exp. Biol. Med.*, 1945, 58, 188.
3. Gildemeister, E., and Haagen, E. *Dtsch. med. Wschr.*, 1940, 66, 878.
4. Plotz, H. *Science*, 1943, 97, 20.
5. Plotz, H., Wertman, K., and Bennett, B. L. Withheld from publication.
6. Topping, N. H., Bengtson, I. A., and Henderson, R. G. Withheld from publication.
7. Veintemillas, F. *J. Immunol.*, 1939, 36, 339.
8. Zinsser, H., and Castaneda, M. R. *J. exp. Med.*, 1933, 57, 391.
9. Zinsser, H., and Castaneda, M. R. *J. exp. Med.*, 1934, 59, 471.

The Target Area of Mammalian Red Cells

Eric Ponder

The Nassau Hospital, Mineola, New York

When a suspension of N red cells is placed in a beam of parallel light, its opacity depends in a complex way on the projected area, or "target area," which the cells present in the direction of the light (*3*). As extreme cases, all the cells might be oriented edge-on, or all face-on, and in the former case the opacity would be less than in the latter because the target area is smaller. When the cells are oriented at random, the target area, T, is somewhere between these two extremes. Although the mammalian red cell is a biconcave discoidal body, all its possible projections in a beam of parallel light are those of a similar discoidal body in which the biconcavities are replaced by two planes, one on each side of the cell, passing through the circles of points along the greatest thickness of the rim. We can thus obtain a simple solution of what has been hitherto a troublesome problem by using a little-known theorem which was proved by Cauchy and to which attention has recently been called (*1*): If a body is convex and has area A, A is equal to four times the mean of the area of the projection of the body on a plane for all orientations of the latter. To find the target area of a suspension of red cells oriented at random, we have therefore to find the area, A, of a body of the same shape as that of the average red cell, except that the biconcavities are replaced by the planes described; the target area, T, will then be equal to $NA/4$.

Computations of A have been made from scale drawings of the average red cells of several animals (*2*), using Pappus' theorem for the surface of a solid of revolution. The values are given in Table 1, which also gives the values of S, the surface area of the biconcave discoidal red cell.

TABLE 1

Cells of	A, μ^2	S, μ^2
Man	144	163
Rabbit	100	110
Elk	71	79
Sheep	60	67
Tahr	24	27

The ratio A/S varies from 0.88 to 0.91 in these five types of red cell, and, while the mammalian erythrocyte is by no means constant in shape in all species, it is probably good enough for the purposes of opacimetry to take A as equal to 0.9 S.

The target areas corresponding to the *spherical* forms of the red cells of man, the rabbit, and the sheep are $N \times 25\,\mu^2$, $18\,\mu^2$, and $12\,\mu^2$, respectively.

References

1. Moran, P. A. P. *Nature, Lond.*, 1944, 154, 490.
2. Ponder, E. *Quart J. exp. Physiol.*, 1930, 20, 29.
3. Ponder, E. *Amer. J. Physiol.*, 1941, 134, 739.

Soil Nitrogen and Thrips Injury to Spinach

S. H. Wittwer and Leonard Haseman

University of Missouri

That the nutritive qualities of agricultural crops are influenced by the fertility of the soil on which they are grown is a well-established fact. Also, that a relationship exists between soil fertility and the production of plants resistant to, or unsuitable as food for, insect pests has been demonstrated by recent work at the Missouri Agricultural Experiment Station (*2*). Some of the possibilities in this as yet little explored field of entomology have recently been suggested by a striking relationship observed between the amount of soil nitrogen provided for spinach plants and their "resistance" to attack by the common greenhouse thrips (*Heliothrips haemorrhoidalis*).

New Zealand spinach was grown under controlled conditions in gallon glazed crocks using colloidal clay cultures (*1*). A series of 16 soil treatments was prepared by supplying calcium and nitrogen levels each of 5, 10, 20, and 40 milliequivalents per crock with all possible (*i.e.* 16) combinations in these amounts of the two nutrients. Each series was replicated 10 times. Calcium acetate and ammonium nitrate were the respective sources of the variable elements, and all other nutrients were provided in constant amounts for all treatments. The plants were placed in a greenhouse infested with thrips, the insects being left free to choose whatever plants they wished. During the first month of growth, of the 320 plants in the experiment, not one of the 160 plants grown at the two higher nitrogen levels was noticeably attacked by the insect. This condition was in sharp contrast to that observed on an equal number of plants grown at the two lower nitrogen levels, of which practically all were seriously damaged. It was also of significance that when the calcium supply was increased, the insect attacks on the low-nitrogen groups were less serious.

As the same plants matured and the transition from vegetative to reproductive development was initiated, an unexpected phenomenon characterized the feeding habits of the thrips. In the two lower calcium series they shifted from the plants grown on soils low in nitrogen to those highest in this nutrient, while the damage in the higher calcium groups practically ceased for all treatments. As a result of greater vegetative growth, the plants with low calcium and originally supplied with adequate nitrogen had probably approached the unbalanced nutritional status characteristic of those provided with the least nitrogen at the beginning, since no additional nutrients had been added during the course of the experiment. The insects invariably selected as food those plants of a lighter green color. Even on the same plant, the thrips always chose the older, more mature leaves in preference to those younger and higher in nitrogen. In general, as long as the crops made a vigorous luxuriant growth as a result of an adequate nitrogen supply, they were practically immune from insect attack.

For a proper interpretation of these observations, one should be mindful of the following items of interest: (a) most insects have specific hosts, signifying, perhaps, that they have definite food requirements to satisfy; (b) the nutrient contribution of the host plant may be altered tremendously by soil fertility, especially, as in this case, when the nitrogen is varied (*3*); (c) the long-recognized value of crop rotation in pest control may be, in part, a result of better maintenance of soil fertility and consequent greater "plant resistance"; (d) the explanation as to why some crop pests, such as codling moth, become more serious as fruit trees are grown continuously on the same soil without a complete renewal of the nutrients removed may be found, in part at least, in soil deficiency; and (e) possibly the continuing need for the creation of new insecticides to hold in check greater and more destructive ravages of insect pests is aggravated by the gradual, but general decline in soil fertility from year to year.

References

1. ALBRECHT, WM. A., and SCHROEDER, R. A. *Proc. Amer. Soc. hort. Sci.*, 1939, 37, 689–692.
2. DELAPLANE, W. K., JR. Master's thesis, Univ. Missouri, 1940. Unpublished data by Leonard Haseman and P. C. Stone.
3. WITTWER, S. H., SCHROEDER, R. A., and ALBRECHT, WM. A. *Soil Sci.*, 1945, 59, 329–336. Also unpublished data.

Obituary

D. F. J. Lynch
1891-1945

Final rites for D. F. J. Lynch, director of the Southern Regional Research Laboratory of the Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, were held in New Orleans, Louisiana, on 16 October 1945.

Mr. Lynch, a native of Boston, Massachusetts, died at his residence on 15 October 1945 following a week's illness. He was 54 years old.

Widely known as a chemist, Lynch came to New Orleans six years ago when the Southern Regional Research Laboratory was built. He had been connected with the U. S. Department of Agriculture for twenty years and had gained fame for developing a method for the production of cellulose from sugarcane bagasse.

Lynch was chairman of the Louisiana chapter, American Institute of Chemists, a member of the American Chemical Society, and an active member of the Army and Navy Club of New Orleans. He was a veteran of World War I.

In 1934–35, Mr. Lynch supervised the construction and operation of a semicommercial plant in Hawaii for the production of cellulose and in 1938 directed a survey of research being carried on in the Southern States by federal, state, and private laboratories on industrial utilization of agricultural commodities. Prior to assuming his post at the New Orleans laboratory, Mr. Lynch directed the U. S. Government By-Products Laboratory at Ames, Iowa.

He received his A.B. and A.M. degrees in chemistry from Harvard University and LL.B. and LL.M. from the Georgetown law school in Washington, D. C.

JOSEPH T. HOGAN

U. S. Department of Agriculture

News and Notes

Dr. Walter J. McNamara has been made consultant in educational tests and measurements in the IBM Department of Education. Dr. McNamara will serve as director of educational research for the entire IBM educational program. His services will also be available to educational institutions for professional consultation on problems and procedures in test scoring and educational evaluation.

Dr. Robert B. Jacobs has joined the staff of Distillation Products, Inc., Rochester, New York, where he will direct the work of the physics laboratory, which is concerned with the study of physical phenomena at low pressures.

Hobart E. Stocking, for the past year visiting professor of geology at the University of Costa Rica, has joined the staff of the New Mexico Bureau of Mines and Mineral Resources at Socorro as geologist and editor. His work will include the preparation of a series of popular articles on New Mexico's geology and mineral industry.

Dr. Ellinor H. Behre, on leave for a semester from Louisiana State University, occupied the position of visiting research professor at the Colegio Agricultura of the University of Puerto Rico at Mayaguez. Dr. Behre was engaged in studies of marine invertebrate life histories, especially those of Crustacea.

Dr. Donald Wilson Hastings, former chief psychiatrist of the Eighth Air Force in England and later chief air force psychiatrist in Washington, has been appointed by the University of Minnesota Board of Regents as professor and head of the Department of Neuropsychiatry in the Medical School. Dr. Hastings will fill the vacancy left by the illness and resignation of Dr. J. Charnley McKinley.

Dr. E. Willard Miller has been made associate professor and chief of the Division of Geography at Pennsylvania State College.

W. W. Grigorieff has been appointed director of the ORDARK Project at the University of Arkansas, Fayetteville. He was formerly laboratory section head at the General Electric Company in Pittsfield, Massachusetts.

Dr. Albert Frederick Bickel has joined the Department of Research in Pure Chemistry at Mellon Institute as the recipient of a postdoctoral fellowship for one year of study offered by the Institute to an organic chemist of Dutch nationality. In that capacity Dr. Bickel, who was selected by the Netherlands Ministry of Education, will continue with advanced organic investigation, and it is expected that the grant will aid him in becoming familiar with recent scientific progress in the United States and with new American research techniques.

Dr. Frederick J. Moore, of the Department of Experimental Medicine, University of Southern California, is actively engaged in a study of heteropolar antiseptics in general surgery. His work is supported in part by a research grant in the amount of $5,000 from the Medical Research Division of Sharp and Dohme.

Dr. Loyd E. Harris has been made professor of pharmaceutical chemistry at the College of Pharmacy, Ohio State University. Dr. Harris has recently returned from the second of two tours of overseas duty, where he served with chemical warfare intelligence and made a survey of the German chemical industry.

Olaf P. Bergelin, captain in the Corps of Engineers and recently associated with the Manhattan District, has been appointed assistant professor of chemical engineering at the University of Delaware. Dr. Bergelin will take over immediate direction of a cooperative research project on heat exchangers.

Dr. Ismael Vélez, principal botanist of the Institute of Tropical Agriculture, at Mayaguez, Puerto Rico, while on sabbatical leave of absence from Polytechnic Institute, San German, is leaving for Venezuela with Mr. Ventura Barnes, Jr., on an exploration trip to the Amazonas region.

Dr. Edwin T. Mertz, biochemist, has been appointed assistant professor of agricultural chemistry at Purdue University. For the past three years he has been a research chemist at the Hercules Powder Company Experiment Station, Wilmington, Delaware.

Dr. A. E. Alexander, formerly with the B. G. Corporation, New York City, has assumed directorship of the Gem Trade Laboratory, Inc., 608 Fifth Avenue, New York City. This laboratory, designed primarily for the testing of pearls and precious stones, is supported by the leading gem and pearl dealers of New York.

Dr. William H. Griggs of Kirksville, Missouri, has been made an assistant professor of pomology at the University of Connecticut, Storrs.

William G. Hoyt, Interior Department, has been elected chairman of the Executive Committee of the

American Society of Civil Engineers' hydraulic division.

Capt. Ralph Decker Bennett, USNR, has been awarded the Legion of Merit for outstanding services while attached to the Naval Ordnance Laboratory in Washington, D. C. Capt. Bennett, who left Massachusetts Institute of Technology to begin active duty in the Naval Reserve in 1940, is technical director of the Laboratory.

The presentation was made only a few days after Capt. Bennett had been awarded the decoration of Honorary Officer of the Military Division of the Most Excellent Order of the British Empire—twentieth highest of 124 decorations authorized by the Crown. The NOL scientist, who spent a number of months at United Kingdom laboratories during the war, received the award from Ambassador Lord Halifax at the British Embassy in Washington.

Naval Ordnance Laboratory is the Navy's headquarters for the design and development of mines, depth charges, and assorted underwater weapons. Its research scope will be further extended when the Laboratory is moved into the new $15,000,000 science campus at White Oak, Maryland, later this year.

Announcements

The first invention in 200 years involving a new projection to show the map of the world on a flat surface was patented by R. Duckminister Fuller, Wichita engineer, on 30 January 1946.

Awards amounting to 10,000 pounds were made in London on 22 January to the three scientists who discovered and developed penicillin. According to *The Times,* Sir Alexander Fleming received 5,000 pounds, and Sir Howard Florey and Dr. Boris Chain, his two co-workers, received 2,500 pounds each. They were recently jointly awarded the 1945 Nobel Prize for medicine. The gifts were from a 25,000-pound trust fund created in 1924 by Sir Harold Harmsworth and his father, the late Sir Leicester Harmsworth, to encourage research into the causation and treatment of infective endocarditis. Lord Horder made the presentations at a luncheon given by Sir Harold Harmsworth at the Savoy Hotel.

The Meritorious Service Plaque was awarded to the Army Institute of Pathology on 7 February. The director of the Institute is Col. J. E. Ash.

The American Society of Mechanical Engineers, through its Committee on International Relations, has issued an appeal to engineers throughout the country to assist with gifts of technical books and periodicals to replace those lost or destroyed in war-devastated areas. Donations of money will be used to buy new books for foreign technical libraries.

To spend eight months studying jungle life in Venezuela, Dr. William Beebe and the staff of the New York Zoological Society's Department of Tropical Research sailed on 10 February for the Society's field station at Rancho Grande, Venezuela. The expedition will make its headquarters in 18 rooms of a huge, unfinished concrete building in a forest west of Caracas, at an elevation of 3,500 feet. The surrounding area is a national park and abounds in mammal, bird, reptile, and insect life. The expedition was scheduled to arrive at Rancho Grande on 18 February. This is the department's second expedition to Rancho Grande.

An Annual Review of Microbiology will be published by Annual Reviews, Inc. The Review will be similar in format and in organization of subject matter to the *Annual Review of Biochemistry* and the *Annual Review of Physiology.* The new Review will appear under the direction of an editorial committee consisting of Drs. Monroe D. Eaton, Department of Public Health, Berkeley, California; Wallace E. Herrell, Mayo Clinic, Rochester, Minnesota; C. B. van Niel, Hopkins Marine Station, Pacific Grove, California; J. M. Sherman, Cornell University, Ithaca, New York; E. C. Stakman, University of Minnesota, St. Paul, Minnesota; and W. H. Taliaferro, University of Chicago.

Prof. Charles E. Clifton, Stanford University, has been appointed as editor, and Profs. Sidney Raffel, Stanford University, and H. A. Barker, University of California, will serve as associate editors. The first volume is expected to appear in November 1947.

George Washington University has established a Department of Geography. Dr. Louis O. Quam will direct the department, with Dr. Myron L. Koenig, dean of the junior college, as associate professor. Dr. Robert W. Richardson, of the State Department's office of research and intelligence, has been appointed professorial lecturer.

Dr. Kenneth W. Vaughn writing in the Fortieth Annual Report of the Carnegie Foundation, says: "Unless the college has definitely fixed its objectives, formulated the means proposed for attaining them, and specified the results expected from the use of such means, it is extremely difficult to ascertain to what extent progress is being made."

The Sinai Hospital of Baltimore announces the establishment of the Alfred Ullman Laboratory for neuro-Psychiatric Research. The work in the laboratory will be carried out under the direction of Dr. H. S. Rubinstein.

The Pharmacology Department of the School of Medicine, University of Georgia, has announced grants totaling $5,400 for the year 1946 from Frederick Stearns and Company, Eli Lilly and Company, and Ciba Pharmaceutical Products, Inc. These funds are to support fellowships and technical help in investigating the pharmacology of the uterus in pregnancy and dysmenorrhea. One of these fellowships will be available in September 1946 with opportunity for the fellow to take part-time medical work.

The Perkin Medal for outstanding achievement in the field of industrial research was awarded to Dr. Francis C. Frary, director of research, Aluminum Company of America, on 11 January for "distinguished additions to the chemistry of aluminum." The award was made at a dinner at the Hotel Commodore, given by the Society of Chemical Industry, with the American Chemical Society, the American Institute of Chemical Engineers, the Electro Chemical Society, and the Société de Chimie Industrièle participating.

The Perkin Medal, according to *The Christian Science Monitor,* which reported the event, was founded in 1906 in commemoration of the fiftieth anniversary of the coal-tar color industry. The original medal was awarded to Sir William H. Perkin, who was the first to find out how to produce an artificial dyestuff. This dye led to the foundation of the coal-tar color industry of today. The medal is awarded annually to any chemist residing in the United States for distinguished services to the chemical industry.

Dr. Frary is the fortieth recipient of the medal and the second chemist on the staff of Aluminum Company to be so honored. In 1911 Charles Martin Hall was given the medal for his development of the present-day process for the manufacture of aluminum. Some of the other recipients of the medal include: Dr. E. G. Acheson, who discovered artificial graphite and carborundum; Dr. Leo H. Baekeland, a pioneer in synthetic resins, and after whom bakelite is named; Dr. Irving Langmuir, whose name is associated with the gas-filled tungsten lamp; Dr. Thomas Midgley, Jr., who gave us ethyl gasoline; and Dr. E. K. Bolton, under whose direction neoprene and nylon were developed.

A comprehensive gynecology survey of women in Texas state institutions is being organized under the direction of Dr. Willard R. Cooke, professor of obstetrics and gynecology at the University of Texas Medical Branch, Galveston, and his associate, Dr. John W. Weaver. This survey is being made in cooperation with the State Board of Control, Judge Weaver Baker, chairman. It is supported by a three-year grant of $20,000 from the Lilly Research Laboratories of Indianapolis.

The Graduate Record Examination, sponsored by the Carnegie Foundation for the Advancement of Teaching, has now entered its ninth year. More than 6,500 students took the Examination at 208 educational centers, including 11 in Canada, during the past year. The number of complete scorings made in the last seven years exceeded 45,000. The Examination was extended to 98 higher institutions, a gain of about 35 during the year. All of these required or invited applicants for admission to graduate or professional study to submit results of the Examination as auxiliary credentials. More than one-third of the total number of institutions require the Examination of some or all classes of applicants.

The Examination, essentially a test of the student's knowledge over broad fields of subject matter, measures achievement in mathematics, physics, chemistry, biology, social studies (including history, economics, and government), literature, and fine arts. A verbal factor test is required. Advanced tests are available in major fields of specialization. Results are presented graphically in profiles, which reveal the standing of the student as to individual accomplishment and as a member of the tested group.

The Examination is under the direction of Dr. William S. Learned.

The Carnegie Foundation for the Advancement of Teaching reports that among the 67 educators and scholars receiving retiring allowances from the Foundation who died during the year ended 30 June 1945, 17 were in their eighties, two were in these nineties, and one died at the age of 100 years, 7 months, and 1 day.

The University of Utah School of Medicine announces the following additions to its staff: Dr. Randolph T. Shields, formerly surgery resident at the University of Pennsylvania, and more recently Major in the U. S. Army Medical Corps in the China-Burma-India Theater, has been appointed instructor in surgery. Dr. Crichton McNeal, now stationed at the Army Institute of Pathology in Washington, D. C., has been appointed instructor in pathology. Dr. David W. Morgan, now at the Regional Hospital, Camp Swift, Texas, has been appointed clinical instructor in psychiatry.

The University of Colorado announces that field courses in geology and biology will again be offered at Science Lodge, the University's high-altitude mountain laboratory in the Colorado Rockies. The work will be given in two terms, 17 June to 19 July, and 22 July to 23 August. Courses in geology will be provided for beginners, intermediate, and advanced students. In biology the courses will be largely for intermediate and advanced students. For information, write to the Dean of the Summer Quarter, University of Colorado, Boulder, Colorado.

During the 1914–1918 war 34,000,000 maps were printed, but during World War II, between January 1941 and September 1944, 230,000,000 were manufactured, according to Major C. A. Hart, deputy assistant director of the Military Survey, who spoke recently at the Royal Geographical Society, London, on "Modern Maps and How They Are Made." He said that the British issued 9,500,000 maps of North Africa alone before the landings there. The big problem in mapping was presented by areas in the enemy's hands in the Far East, of which there were almost no reliable maps. Great advances in the technique of surveying by air making use of planes fitted with radar and special recording devices were made in this area. Major Hart felt that the application of radar to aerial surveying will reduce the cost of aerial photographic surveying by as much as 50 per cent.

Wyeth, Inc., has made a grant of $6,000 a year to Dr. Franz R. Goetzl of the Department of Medical Research of Permanente Foundation, Oakland, California for experimental and clinical studies in anaphylaxis, and clinical allergy.

A new Department of Geography was established as a separate instructional unit at Northwestern University in the Fall of 1945. Prof. G. Donald Hudson is chairman of the new department while William E. Powers and Harold Ward, formerly members of the Department of Geology and Geography, have joined the new department. Three new appointments, Clarence E. Jones, Edward B. Espenshade, and Clyde F. Kohn, were also made. Prof. George Kiss, of the University of Michigan, will give a summer session course in Political Geography and a graduate seminar in the Geography of Europe.

Forty winners in the Fifth Annual Talent Search, conducted by the Science Clubs of America and administered by Science Service, attended a dinner at the Hotel Statler, Washington, D. C., on 5 March 1946. The event culminated an entire week in which the high school students had attended the Science Talent Institute. From the 40 winners one boy, Jules Alfred Kernen, 16, of St. Louis, and one girl, Marilyn Rohrer, 17, Elizabethtown, Pennsylvania, were awarded the four-year $2,400 Westinghouse scholarships.

Eight additional contestants were awarded $400 each and 30 were awarded scholarships of $100 each for one year. The forty winners had survived successive hurdles in selection which separated them from more than 16,000 original contestants from the 9,200 science clubs in the United States.

Albion College has acquired by gift and purchase 300 acres of land near Battle Creek to serve as its Biological Preserve. Dr. A. M. Chickering outlined extensive new opportunities for field work and observation on such problems as taxonomy of plants and animals, ecology, soil analyses, studies in the character of lake bottoms and other geological features, plankton studies in the Preserve's three small lakes, ornithology, protozoology, surveying, and forest mensuration. The Preserve includes the following types of ecological regions: second-growth upland hardwood, tamarack swamp, lowland hardwood, lowland brush, sedge and grassy marshland, bramble, lake aquatic, meadow herbaceous, a small sphagnum boggy region, and a small moraine running in a sinuous manner through the property.

At the last meeting of the Association Canadienne Française pour l'Avancement des Sciences, the Leo-Pariseau's medal was awarded to Mr. Paul-A. Giguère, of the Department of Physics of Laval University, according to Jacques Rousseau, general secretary of the Association.

A grant of $5,000, in support of clinical research conducted by Dr. C. Gordon Johnson, has been made to the Department of Gynecology, Tulane University Medical School, New Orleans, Louisiana, by the Medical Research Division, Sharp and Dohme, Inc.

Columbia University, College of Physicians and Surgeons, is the recipient of a research grant in the amount of $2,200 from Sharp and Dohme, Inc., in support of Dr. Erwin Brand's work on proteins and amino acids.

The College of Medicine of the University of Tennessee announces the following changes in the clinical staff. Dr. E. C. Mitchell becomes emeritus professor of pediatrics, to be succeeded by Dr. F. T. Mitchell as professor and head of the department. Dr. James G. Hughes has been promoted to associate professor of pediatrics and will devote full time to the department.

Elections

The Southern Section of the American Society for Horticultural Science held its first postwar meeting at New Orleans on 5–7 February. The following officers were elected for 1946–47: Dr. B. L. Wade, chairman; Mr. Otis Woodard, vice-chairman; and Dr. J. B. Edmond, secretary.

The Anthropological Society of Washington announced the following officers for 1946 following a meeting on 15 January: Dr. Regina Flannery, Catholic University of America, president; Mr. H. W. Krieger, U. S. National Museum, vice-president; Dr. William N. Fenton, Bureau of American Ethnology, secretary; Dr. Waldo R. Wedel, U. S. National Museum, treasurer; and Dr. W. M. Cobb, Howard University; Dr. W. H. Gilbert, Jr., Library of Congress; Dr. Margaret Lantis, U. S. Department of Agriculture; and Dr. J. H. Steward and Dr. G. R. Willey, Smithsonian Institution, councilors to serve on the Board of Managers.

Conditions Abroad

Sergei Vavilov, president of the Academy of Sciences of the USSR; Igor Tamm, director, and Pavel Cherenkov, a scientific worker at the Lebedev Physics Institute; and Alya Frank, also of the Academy of Sciences have been awarded Stalin prizes, it was announced in Moscow on 27 January. It is said that the prizes are considered to be the domestic equivalent of the Nobel prize. The dispatch noted that Peter Kapitsa and A. Joffe, two leading physicists, were not among the recipients this year because they had been awarded the prizes previously.

Prof. Jean Firket, Institute of Pathology of the University of Liège, 1 Rue des Bonnes Villes, Liège, Belgium, writes that the Institute has escaped major damage but that part of the equipment is missing. Dr. Firket is reviewing the literature on cancer research and would greatly appreciate receiving from American scientists reprints bearing on the fields of cancer research and pathology.

Cytologists who have lost track of their European colleagues may find the following addresses of help. They have been obtained through the assistance of Dr. Meitès and of the former Office of War Information:

Dr. Marc Meitès, chargé de recherches au Centre National de la Recherche Scientifique, and M. le Professeur J. André Thomas are both at the Institut du Radium, 26 rue d'Ulm, Paris (5^{e}). Others are: M. Pierre Gavaudan, Laboratoire de Biologie Cellulaire, Centre d'Études du Bouchet, Le Bouchet par Vert-le-Petit, (Seine et Oise) France; Dr. Paul Sentein, 1 Place de la Comedie, Montpellier, (Hérault) France; Gunnar Östergren, Fil. lic., Lunds Universitets Inst. för Ärftlighetsforskning, Lund, Sweden.

A letter from Prof. Josef Kisser, plant physiologist and morphologist at Vienna, has been received by Dr. Irma M. Felber, Michigan State College. He says that shortly after the occupation of Austria he was dismissed from his post of full professor at the Hochschule für Bodenkultur, but was granted a small pension which hardly sufficed to support his wife and three children. He managed to continue research as a volunteer at the Biological Experiment Station, although under most unpleasant conditions. He finished several papers before he was drafted in 1941 and sent to the Balkans. In May 1945, after the Russians had occupied Vienna, he resumed his post at the Hochschule, but under great hardship. Since no transportation existed, he had to walk daily two hours from his residence to the Institute. In June classes and laboratory courses started. Now, for the winter term, he has 420 students in his classes and 4 graduates. He also is provisional director of the Botanical Garden and Institute of the University. Prof. Kisser badly misses foreign scientific literature and is asking his American colleagues to send him reprints of botanical papers published since 1941. His address: Hochschule für Bodenkultur, Botanisches Institut, Wien XVIII, Gregor Mendelstrasse 33.

Dr. H. Neumann, Histological Laboratory of the University of Amsterdam, Holland, has written to I. M. Kolthoff, University of Minnesota, urgently requesting that reprints of papers dealing with enzyme-reactions and protein chemistry published during the war be sent to him, since none of this literature is available in Holland.

Prof. Ernst Gaumann, mycologist, Eidg. Technischen Hochschule, Zurich, Switzerland, has written to Dr. L. E. Wehmeyer, University of Michigan, as follows:

> Dr. DeFago was killed in an auto accident. . . . From other countries we know less than you, because we have got the French occupation-zone around us, and this zone is as hermetic as the Russian zone. . . . Anyhow, from the names you ask, Wollenweber is alive, also Pilat. From Cejp and Lohwag I don't know reliable news; I think however, that with Cejp something is wrong. . . . Van Vloten in Holland has lost his wife, who was killed at his side; both his legs were terribly wounded, but there is some hope to get them in order again. Miss Kreitjes has been deported by the Germans. . . . and she has died in a concentration camp. Her sister was deported too; she was released by the Americans, but if I am not mistaken, she has now died too. . . .

In the Laboratory

An Instrument for Determining the Partial Pressure of Oxygen in a Gas[1]

LINUS PAULING, REUBEN E. WOOD,
and J. H. STURDIVANT
*The Gates and Crellin Laboratories of Chemistry,
California Institute of Technology, Pasadena*

In response to a request by the National Defense Research Committee, we developed in the Fall of 1940 a simple and effective instrument for determining the partial pressure of oxygen in a gas. The operation of this instrument depends upon the fact that the magnetic susceptibility of oxygen is very much greater than that of any other common gas: at 20° C. and one atmosphere the volume magnetic susceptibility of oxygen is $+142 \times 10^{-9}$ c.g.s.m.u., whereas that of nitrogen, which is representative of the common diamagnetic gases, is -0.40×10^{-9} c.g.s.m.u. The magnetic susceptibility of a gas is hence determined almost entirely by the partial pressure of the molecular oxygen in the gas;[2] the effect of adding one atmosphere of nitrogen is equal to that of decreasing the partial pressure of oxygen by 0.0028 atmospheres.

The indication of the magnetic susceptibility of the gas in this oxygen meter depends on the behavior of a small test body surrounded by the gas in an inhomogeneous magnetic field. The force on the test body due to the magnetic field is proportional to the difference in volume magnetic susceptibility of the test body and the gas surrounding it. The operation of the instrument is accordingly analogous to the ordinary determination of the density of a liquid by weighing a solid body suspended in the liquid (Archimedes' principle). The test body in the meter is a small dumbbell consisting of two thin-walled glass spheres about 3 mm. in diameter connected by a small glass rod or tube about 4 mm. long; this dumbbell, which weighs about 2 mg., is cemented, together with a small mirror, to a silica fiber about 3 microns in diameter and about 10 mm. long which is stretched across a silica fork. By rotating around the silica fiber, which serves as a torsion balance, the spheres of the dumbbell may move in an inhomogeneous magnetic field. The field is produced by permanent magnets (usually two Alnico V horseshoe magnets weighing about 5 ounces apiece) with suitably shaped soft iron pole pieces. The magnetic susceptibility of the gas in the chamber (with gas volume about 4 ml.) surrounding the test body may be indicated on a scale by a beam of light reflected from the small mirror.

Several hundred of the meters have been manufactured, the first few dozen by the California Institute of Technology, and the others by Dr. Arnold O. Beckman, 11 West State Street, Pasadena 2, California, who took over the production of the meter in the Summer of 1942. The meter is made in several models for various special purposes and to cover various ranges of partial pressure of oxygen. The precision is dependent on the range; it is, for example, about ±1 mm. of mercury for a meter covering the partial pressure range 0 to 180 mm. of mercury. Some recording models of the instrument are available.

Our principal collaborators in the development of the instrument at the California Institute of Technology were David P. Shoemaker, James B. Edson, Harold Herd, Dr. Herbert Sargent, Dr. Charles D. Wagner, and Beckie Bradford. Professor H. Victor Neher gave us valuable advice and instruction in silica-fiber technique.

Quantitative Differentiation of Minute Amounts of the Coproporphyrin Isomers (I and III) Based on Fluorescence Behavior[1]

SAMUEL SCHWARTZ, VIOLET E. HAWKINSON, and
C. J. WATSON
*Department of Medicine, University
of Minnesota Hospitals*

The coproporphyrin isomers have identical absorption and fluorescence spectra (*1*). Other physical characteristics of differential nature, such as the ester melting point and pH fluorescence curves, require relatively large amounts of crystalline material. The concentration of coproporphyrin in normal and pathological urines is usually in the range of 50–500 γ per 24-hour sample, so that any method which requires crystallization prior to determination of the percentage of isomers in the mixture is unsatisfactory, simply because of the time, effort, and expense involved in the isolation of crystalline ester. Essentially the same is true in the case of feces. For the purpose of studying the excretion of the coproporphyrin isomers in health and disease, a relatively simple method was needed which could be applied to small amounts of urine and feces. Some time ago a procedure was described which permitted determination of the percentage of isomers in a mixture of very small amounts (*2*). This depended upon a differential elution of the esters from a Tswett column of aluminum oxide. It was found impossible, however, to apply this method to urine with uniform results except where the porphyrin ester had first been crystallized. This was true even though several hundred alternative methods of purification, preliminary to the elution, were tried. Thus, although the method has considerable fundamental interest and value, it is not of practical usefulness.

---

[1] This work was done in whole under Contract No's. NDCrc-88, NDCrc-200, OEMsr-326, and OEMsr-584 between the California Institute of Technology and the Office of Scientific Research and Development, which assumes no responsibility for the accuracy of the statements contained herein.

[2] The paramagnetic gases, nitric oxide, nitrogen dioxide, and chlorine dioxide, if present, would also contribute largely to the magnetic susceptibility of the gas.

[1] Aided by grants from the John and Mary R. Markle Foundation, New York City, and the Medical Research Fund of the Graduate School, University of Minnesota.

The purpose of the present communication is to record another and hitherto undescribed difference in physical behavior of the coproporphyrin I and III esters. This consists in a marked difference in rate of precipitation in 30-per cent acetone when the range of concentration of the total coproporphyrin is from 25–70 γ per 100 cc. Since as little as 10 cc. of final solution are required, it is evident that the method is applicable to the resolution of mixtures of from 3 to 7 γ of total coproporphyrin. The phenomenon is characterized by a rapid disappearance of red fluorescence in Wood's light in the case of the type I isomer, while with the type III isomer the disappearance is negligible within 1½ hours. In this range of concentration the solution is colorless, and the precipitation is not visible. It is probable that the phenomenon is actually one of colloidal aggregate formation which then proceeds to actual precipitation. Thus, it has been noted that after standing for 1 hour in a 30-per cent aqueous acetone solution, a considerable amount of coproporphyrin I ester will have collected on the sides of the glass tube. At this time the red fluorescence has disappeared, but if the fluid is poured out of the tube and a small amount of chloroform is then poured in, the chloroform quickly gains an intense red fluorescence in Wood's light, obviously having dissolved porphyrin ester which had been deposited on the glass out of the 30-per cent acetone solution.

The data shown in Fig. 1 reveal the striking difference in behavior of the coproporphyrin esters I and III in 30-per cent aqueous acetone at 4° C. The disappearance of fluorescence is slower at room temperature. It is apparent in Fig. 1 that the rate of decline of the fluorescence intensity is considerably greater as the concentration increases above 30 γ per 100 cc. Thus at 30 minutes the fluorophotometer reading decreased from 150 to 80, with a concentration of 30 γ per 100 cc., while with 60 γ per cent the decrease at 30 minutes was from 260 to 20.

The distinction of the two isomers on this basis is *not an absolute one, since there is also a slight diminution* of the fluorescence of coproporphyrin III. The difference in this respect is so great, however, that it permits an approximate determination of the amount of each isomer in a mixture. It should be emphasized that the fluorescence of the coproporphyrin III diminishes more rapidly at higher concentrations, so that these are not suitable for application of the method.

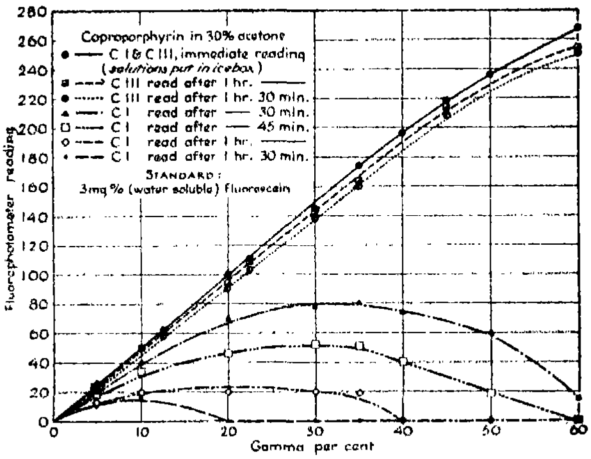


FIG. 1. Fluorescence intensity of the coprophyrin methyl esters (isomer types I and III) in 30-per cent acetone at 4° C. The immediate reading at 0 time was made prior to chilling. The time is constant for all points on each of the curves. The diminution of fluorescence intensity for any given concentration is thus represented by the distance from the 0 curve (immediate reading) to the appropriate curve below.

During the past two years the method has been satisfactorily applied to the coproporphyrin analysis of many 24-hour urine samples, both from normal individuals and in various diseases, 50–250 cc. aliquots being employed for the determination. A considerable preliminary purification is necessary, including ether extraction of the porphyrin from the urine, concentration from the ether by extraction with 5-per cent HCl, methyl esterification, and chromatographic separation of the total coproporphyrin ester on a Tswett column of calcium carbonate, following which the fluorescence intensity in 30-per cent aqueous acetone is measured in a Klett fluorophotometer, using a 3-mg.-per cent aqueous solution of fluorescein as a standard. A reading is taken at once and again after the solution has stood at 4° C. for 1½ hours. The approximate proportions of coproporphyrins I and III in the original mixture are then determined by reference to the data shown in Fig. 1. The validity of the results for both urine and feces has been confirmed repeatedly by means of isolation of the crystalline ester and determination of its melting point. This, of course, merely establishes the predominating isomer type in the original mixture. No discrepancies have been encountered between this and the differential precipitation method as described above.

In order to avoid the necessity of correction for the small residual fluorescence of coproporphyrin I when its initial concentration is less than 20 γ per cent, and for the slight diminution in fluorescence intensity of coproporphyrin III at all concentrations employed (see Fig. 1), a curve has been prepared for various mixtures of the isomers, reference to which permits determination of the percentage of each in a given mixture. These data, together with details of the method as applied to urine and feces and the results obtained in various diseases, will be described in separate communications.

References

1. Fischer, H., and Orth, H. *Die Chemie des Pyrrols.* (Bd. II, 1. Hälfte.) Leipzig: Akademie Verlagsgesellschaft, 1937.
2. Watson, C. J., and Schwartz, S. *Proc. Soc. exp. Biol. Med.*, 1940, **44**, 7.

The Use of Ultraviolet Light in Tracing the Course of a Drug Through the Body

Charles H. Taft

Medical Branch, The University of Texas, Galveston
and
The Marine Biological Laboratory, Woods Hole, Massachusetts

It seems possible, if one takes advantage of the fluorescence of various drugs under ultraviolet light, to trace their course through an animal's body. A timetable of the drug's appearance in the different organs might be set up. The greatest concentration of a drug in, and the disappearance of the drug from, a given organ might be judged by the degree of fluorescence of that organ. This is shown to be true in the case of the quinine derivative, quitenine, which is prepared by oxidizing the vinyl group of quinine to the carboxyl group with a permanganate.

Quitenine was chosen for this purpose because of its intense purple fluorescence and because it can be injected in a fairly sizable dose (2 mM/kg.) without killing the animal. The toadfish (*Opsanus tau*) was used as the experimental animal since considerable knowledge of the action of quitenine on this animal is available (*1*). The drug in doses of 2 mM/kg. as quitenine dihydrochloride was injected subcutaneously into the side of the fish behind the dorsal fin. Sloughs developed at the site of injection in a few days. The fish were killed by a blow on the head and opened just before examination. The source of ultraviolet light was a Hanovia Chemical and Manufacturing Company Inspectolite, which gives a light of about 3,660 A.U.[1] All observations were made in a dark room, with the eyes well dark adapted.

In visible light there is not any significant difference in the appearance of the viscera of the uninjected and injected fish except that there is more variation in the color of the gall bladder in the injected fish. Under ultraviolet light the organs of the uninjected fish show no fluorescence with the following exceptions: the gall bladder shows a faint yellowish fluorescence, and in some cases the full urinary bladder shows a strong white fluorescence.

The injected toadfish were killed at daily intervals, until they showed no more fluorescence than the uninjected fish, and examined under ultraviolet light. For the first six days the markings on the skin are much more noticeable in the injected than in the uninjected fish. The injected animal fluoresces, this being especially noticeable in the eyes. For the first two days after injection the cut edges of the skin and muscles show marked purple fluorescence as does the mixture of blood and body fluid that is in the body cavity. The gut shows a strong purple fluorescence for two days and a weaker one the third day. There is no marked fluorescence at the site of injection until a slough develops. The slough gives a strong purple fluorescence until about the seventh day after injection and then gradually weakens, giving a red fluorescence, probably due to some infection. Organs other than the liver, gall bladder, kidney, ureters, and urinary bladder do not fluoresce with the exception of the ovaries, in which at times the eggs, in injected and uninjected fish, give a brilliant golden fluorescence. This is probably connected with their stage of development and is independent of the drug.

These observations show that when quitenine is injected subcutaneously into the toadfish it is at first widely distributed throughout the body and that a large part of it is rapidly concentrated in the liver. The kidney is a very dense organ, and it would require a high concentration before any fluorescence would show. This is attained by the fourth day, although the excretion had begun on the second day, as is shown by the fact that the craniad end of the ureter shows a purple fluorescence. The drug in the liver begins to disappear on the ninth day, that organ being practically free of the drug by the tenth day. The concentration in the kidney becomes low also on the ninth day, and in at least some fish the detectable concentration in the urine disappears on the tenth day, when the craniad end of the ureter is white and the caudal end shows a purple fluorescence.

---

[1] The writer is indebted to Dr. George A. Lavin of the Rockefeller Institute for Medical Research for the use of his ultraviolet lamp and for much needed advice.

It is shown that it is possible to trace the passage of a fluorescent drug through the body with the use of ultraviolet light. If the drug were injected intravenously it would appear and probably disappear from the organs in a much shorter time. Experiments are in progress to trace various fluorescent drugs in mammals after intravenous administration.

Reference

1. Taft, C. H., and Place, J. A. *Texas Rep. Biol. Med.*, 1944, 2, 61–76.

Modification of Metabolism Apparatus[1]

W. James Leach

Department of Biology, Temple University

Basal metabolism in man is commonly calculated on the basis of oxygen consumption. Clinical types of testing apparatus are designed for determining either (1) the amount of oxygen consumed during a definite period of time or (2) the time required for the consumption of a definite quantity of oxygen. The principal advantages in using a clinical type of apparatus are in their simplicity of operation and in computation of results. This type of apparatus is, however, not well adapted for metabolism studies that involve other than resting or basal conditions. The purpose of this report is to describe a modification of a standard type apparatus to broaden its usefulness in studies of oxygen consumption under various conditions of activity.

The essential feature of the present modification is the inclusion of a regulator valve and rate-meter tube (Rotameter),[2] which is inserted in the oxygen intake line of a standard closed-circuit apparatus of the Benedict-Roth type. The setup is shown in Fig. 1. With these additions, oxygen can be delivered at constant and measured rates simultaneously with the consumption. By adjusting the flow from a predicted demand (from standard tables) to the actual requirements a direct reading of the consumption can be made. In this case the oxygen-consumption line becomes parallel to a horizontal base line (Fig. 2, line A).

A brief discussion of the data shown in Fig. 2 will illustrate a method of using the apparatus and suggest further applications.

The initial oxygen-consumption line (A) was obtained on a subject by adjusting the flow to 260 cc. O_2 per minute, at which point the delivery and consumption balanced. This amount was delivered at 30 lbs. pressure throughout the test period, and represents the oxygen requirement under resting conditions (after one hour reclining). At (B) the subject was detached from the circuit, and while prevented from respiratory exchange with outside air, he ran down and up a flight of stairs and then was reconnected into the circuit. The duration and character of the recovery period (payment of oxygen debt) is shown by the curve (C), and the amount of oxygen required for performing the work is represented by the vertical distance between the level of the initial resting line (A′) and the secondary oxygen consumption line (D). The line (D), in leveling off, shows that full recovery has been effected.

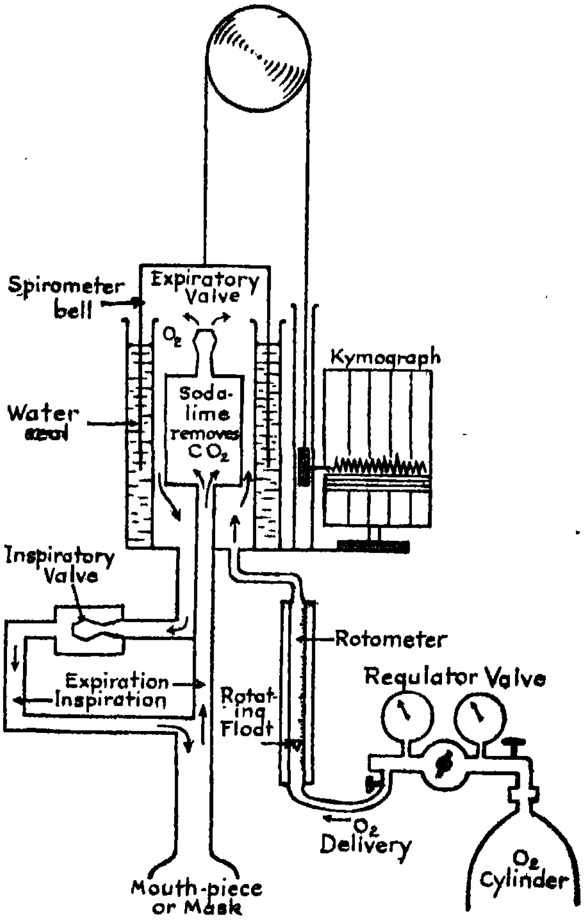


FIG. 1. A diagram of metabolism apparatus of the Benedict-Roth type showing the assembly of the regulator valve and Rotameter.

Calibrations of the particular Rotameter which we have been using give accurate deliveries within a range of from 200 to 800 cc. per minute. In this range the float moves through a distance of 125 mm. This Rotameter was designed to measure small flows of liquids used in aviation equipment. Obviously, a tube of greater length with a similar range of delivery would aid in more precise reading.

---

[1] I am especially indebted to Mr. George K. Porter, of Hatboro, Pennsylvania, technical authority on Rotameters; to Mr. Harold A. Hopkins, Philadelphia service representative for Benedict-Roth apparatus; and to Mr. Warren E. Collins of Boston, who supplied some of the materials with which a bellows type apparatus (mentioned in text) was constructed.

[2] The "Rotameter" is a flow-rate meter of the "variable area" type. The metering element is a rotating free float operating in a precision, taper-bore tube, which is calibrated to give a direct reading of the rate of flow.

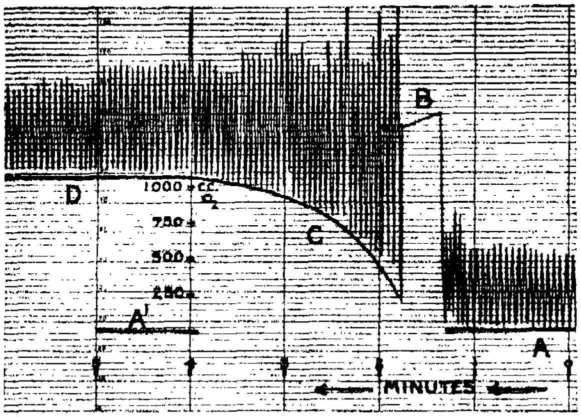


FIG. 2. A kymographic recording of the effect of a stair-climbing exercise on metabolism. Note recovery period as shown by the curve (C).

Corrections for temperature and pressure for the Rotameter delivery are negligible and may be disregarded. Such corrections, however, are necessary for gas in the spirometer.

My principal purpose in designing the modification was for use in connection with class work of a course called "Applied Physiology." The report is given here with the thought that investigators more especially interested in metabolism studies may be better able to further develop the present modification. Our experience with the apparatus as shown in Fig. 1 indicates the desirability of redesigning other parts of the apparatus, especially for use with the Rotameter. One modification we have tried is the substitution of a respiratory bellows in place of the water spirometer. This makes respiratory movements much easier on the subject but increases difficulty of computations. Refinements in the construction and assembly of the apparatus would obviously contribute to greater accuracy and also further broaden its application.

Letters to the Editor

The McDonald Observatory

Your announcement of appointments at the Yerkes and the McDonald Observatories (*Science*, 1946, 103, 80), should be corrected to the effect that the McDonald Observatory is a part of the University of Texas and not of the University of Chicago. Appointments for both observatories are made by the University of Chicago, but the University of Texas owns the McDonald Observatory and approves the appointments.

OTTO STRUVE, *Director*
The W. J. McDonald Observatory, Fort Davis, Texas

Museum of Science and Industry

In *Science* (1946, 103, 17) you refer to our sister institution in New York as "The Museum of Science and Industry." This is misleading even though you add the words "Rockefeller Center, New York." We feel, in view of the history of the two institutions, that we are entitled to have our museum associated with that name.

The New York museum was founded under the name of "The Museum of the Peaceful Arts," while ours carried the name "The Rosenwald Industrial Museum." When we changed our name to "The Museum of Science and Industry," they changed to "The New York Museum of Science and Industry." At that time we protested the close copy of our name, but they declined to change, claiming that the qualifying words "New York" made the distinction clear. Certainly, to leave off these words is unfair to this institution, which considers itself entitled to its proper designation before the public. We will appreciate your consideration of this point.

RUSSELL H. ANDERSON
Museum of Science and Industry, Chicago

Malaria and Rainfall Periodicity in Palestine

The war has demonstrated the vital necessity of medicogeographical work. Yet, in order to be useful, it seems to us that future work in this field should avoid some of the pitfalls found in Dr. H. de Terra's "Rainfall periodicity in relation to malaria and agriculture in the Near East" (*Science*, 1945, 101, 629–631).

Studies in medical geography should be based not only on geography, but equally on medicine. Of course, excessive or insufficient regional rainfall is one of the causal factors of malaria epidemics, and such correlations have been attempted since the time of Hippocrates. (A. Hirsch has provided a survey of such attempts, which were particularly numerous about a hundred years ago, in *Handbook of Geographical and Historical Pathology*. London, 1883, Vol. I, pp. 258 ff.) It is not possible, however, to predict malaria epidemics simply on the basis of probable maxima of rainfall, for to do so is to reduce the complicated process underlying a malaria epidemic to one simple factor: the quantity of anopheles. (I. J. Kligler, who is one of Dr. de Terra's main sources, makes the following important strictures on the use of rain statistics in *The epidemiology and control of malaria in Palestine* (Chicago, 1930): "The importance of rainfall as a factor in the formation of breeding places depends as much—sometimes more—upon the distribution as upon the total volume" (p. 6). "Most of the anopheles breeding places in Palestine are due however either to century old neglect by man or to man's carelessness" (p. 11).) We know today that fluctuations in the *immunity* of the population are an essential factor in the genesis of a malaria epidemic (L. W. Hackett. *Malaria in Europe*. London, 1937, pp. 217 ff.). Fluctuations in spleen mass which express the amount of "immunity" or "premunition" seem to offer a far more reliable factor for prediction of malaria epidemics than rainfall curves. Preceding years of drought, which reduce endemicity and therefore premunition, and which break down the cattle barrier, may in this sense contribute at least as much to an epidemic as the rainfall period itself. There are other possible factors also, e.g. increased gametocyte production, which should be taken into consideration.

In a region such as Palestine, where the rate of malarial infection is always high, the mass importation of nonimmunes is likely to be more important in setting off an epidemic than the importation of carriers. This is applicable to the situation in Palestine in 1917 when soldiers, and to other years when colons and laborers, were moved about in large numbers. In addition to these, the social dislocations of war bring many other disturbances which are conducive to spreading malaria. It seems more likely that Greece and the Balkans suffered from similar epidemics in 1917 because of similar sets of causes, some of which were social, than because of "similar rainfall regimes" with Palestine, which they do not have. (Palestine has a typical Mediterranean regime of winter cyclonic rain and summer drought. Except for Greece, none of the Balkans has such a rainfall distribution. The Adriatic coast is an area of high year-round rainfall. The rest of the Balkans, except Greece, are marked by a strong concentration of summer convectional rains.) One should note in this connection that parts of France and Flanders, certainly not similar to Palestine in rainfall regime, also had epidemics in 1917.

The weakness of a unitary explanation of malaria in Palestine is illustrated by the impossibility of predicting malaria in Palestine from de Terra's graph. The graph would, for instance, suggest epidemics at least in 1914 and 1929. But no such epidemics were observed. It will be shown below that the evidence is not good for epidemic malaria in the years noted on the graph. These contradictions can be understood only if all factors contributing to malaria epidemics are taken into account. One of the most important is social change. Even if excessive rain should occur in cycles of 10 to 12 years over the Holy Land, its chances of producing a malaria epidemic would depend largely on its always encountering equally miserable socioeconomic conditions and equally susceptible populations. This, fortunately, is neither necessary nor likely.

These methodological considerations are independent of the validity of the data on epidemics and rain cycles. Unfortunately, the evidence advanced for epidemics in 1904, 1911–12, and 1926 seems inadequate. That Cropper found a high rate of infection in 1904–05 is no reflection of an epidemic in this period, but simply of the fact that he made his inquiry in those years. The same holds good for the data of Bruenn and Goldberg in 1911–12. The epidemic of 1917–19 did not actually conform to rain statistics and stop in 1919, as de Terra assumes, but continued into 1920 and 1921 (see Kligler, p. 157). The data concerning the "epidemic of 1926" which we have been able to collect are far from indicating a "rapid rise of malaria infections" in 1926. For example, G. J. Schneider (*Organisation und Erfolg der Malaria Bekämpfung in Palästina*. Jena, 1928) has collected the following data:

Percentage of malaria cases in all clinic patients		Infections in region supervised by Malaria Research Units
1922	7.17	68.4
1923	4.90	84.8
1924	4.12	18.2
1925	2.27	9.8
1926	2.04	11.0

Spleen index census

November 1925 .... 4.6 per cent
November 1926 .... 1.7 per cent

The rainfall cycles are equally open to doubt. The theories of correlation of sunspot maxima and rainfall, and of the cyclic occurrence of rainfall maxima, are too speculative for anyone to be able as yet to interpret unanalyzed curves in accordance with them.

Although de Terra states that for Palestine "meteorologic recordings go back sufficiently in time to permit of definite conclusions as to the periodicity of rainfall and water supply," such periodicity is neither evident in his figure nor demonstrated in his text. He shows rainfall curves for three stations for the years 1874 to 1939 and for the fourth station an unbroken record only from 1920 to 1938. The last is too short to be useful except in comparison with the other curves with which, however, it shows poor correlation. The three long-range stations also show poor agreement with each other. A very wet year at one station is a very dry year at another. It is difficult to see any way of predicting rainfall from such irregular curves.

The agreement with the solar cycles shows the same picture. Wet periods of individual stations occur both at sunspot maxima and minima. One must ask if there is even a rough correlation. De Terra states that he has under way a special study on possible periodic shifting of the cyclonic storm tracts in the Eastern Mediterranean. It is to be hoped he will demonstrate more clearly any periodicity he may find in his data.

It may well be that one of the necessary conditions for a malaria epidemic in Palestine is maximum rainfall. But even if rainfall periodicity could be "better recognized and substantiated," it is unlikely that this alone could "lead to the prediction of conditions conducive to malaria epidemics." No one expects Dr. de Terra to be a malaria expert. We regret, however, both that he did not analyze his climatic data further and that he did not collaborate with other scientists who could have helped him better to evaluate the role of weather and climate in malaria. Any effort in the field of medical geography is highly desirable, and should be encouraged; but we feel that in order to contribute effectively to a scientific understanding, medical geography will have to study the phenomena in all their complexity and keep clear from premature and oversimplified conclusions..

Erwin H. Ackerknecht, M.D.
George F. Carter, Ph.D.
The American Museum of Natural History
The Johns Hopkins University

Supplementary statistical data which I received, after publication of my article, by courtesy of the president of the Hebrew University of Jerusalem, and which are at present not available to me in Mexico, show rather well the relationship between rainfall maxima and peaks of malaria mortality. Even if the data given for previous malaria incidence in Palestine are inadequate, it is nevertheless suggestive to see the epidemics of (if I remember correctly) 1935 and 1939–40 occurring in years of greater rainfall. As for the irregularity of the rainfall cycles, seemingly apparent for certain stations, it must be remembered that such discrepancies may well be due to local microclimatic factors arising out of peculiar topographic location. However, this cannot distract from the general impression of periodicity. As for the cyclic control of these epidemics, it would seem that late spring rains in between the major rainfall peaks possibly introduce another climatic element which deserves further study in relation to malaria epidemics. While it is apparent that present data are suggestive rather than conclusive, I would personally only welcome a fuller investigation of this important problem of medical geography, not only through closer cooperation with medical specialists but through an effective and intensive field study in the Near East. Only thus will it be possible to eliminate the inadequacies disclosed by this discussion.

H. de Terra

Mexico, D. F.

Virus Encephalomyelitis in Buffaloes

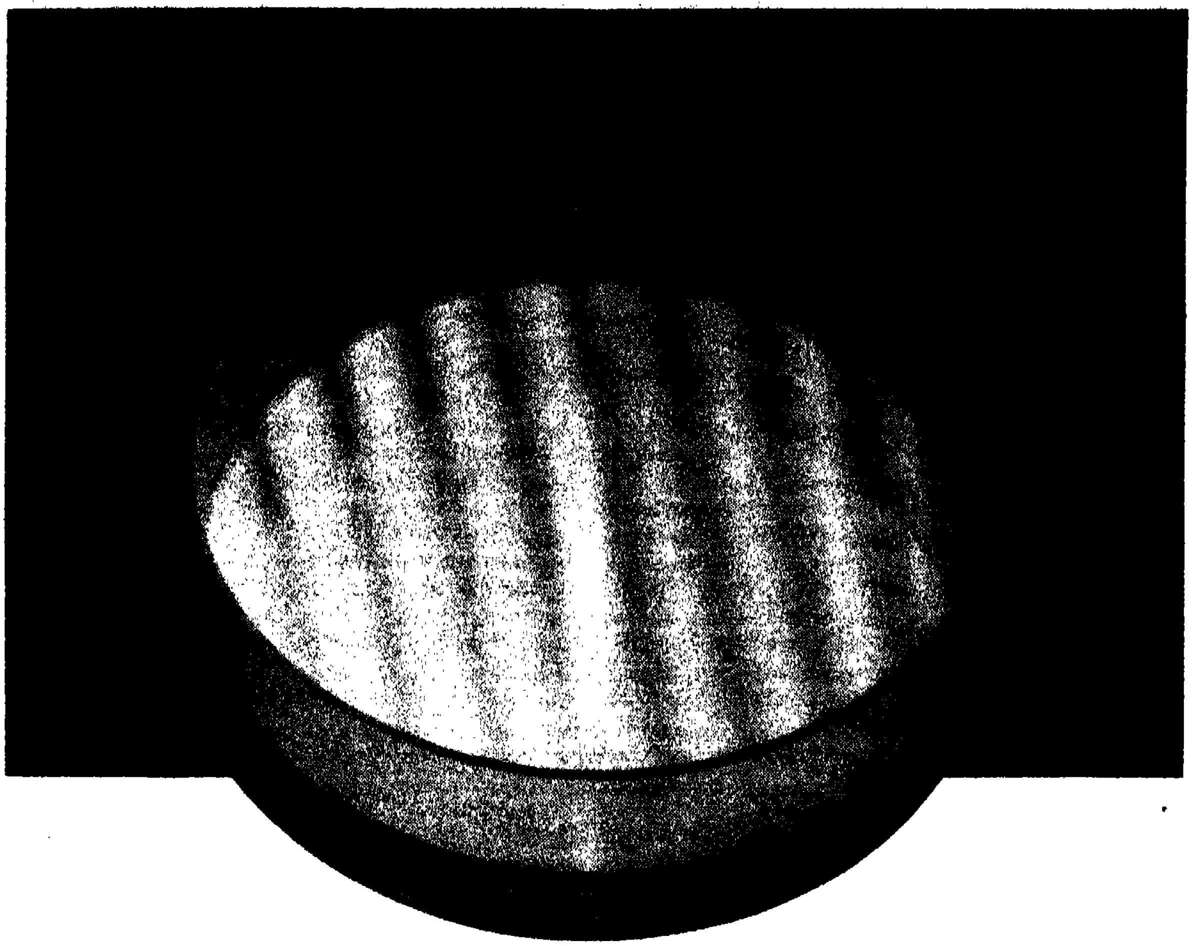
In the western part of the Szechuan province, China, there is a disease among water buffaloes known as "Szegiao-han" (meaning "four-legs-cold") to the farmers. It occurs more in wintertime than in the hot seasons, and young and old buffaloes seem to be equally affected. Its occurrence in other provinces is also suspected, though not proved. A report of the disease in the scientific literature has not appeared before.

Onset of the disease is usually abrupt. The first symptom is a paralysis of the hind legs and inability to stand. The paralysis quickly extends to the fore legs and may be of either a spastic or flaccid type. Animals apparently well the day before may be found lying ill in the stable the next morning with all four legs rigidly extended. The body temperature is usually subnormal from the beginning of the illness. As death approaches, it often drops to below 35° C. Only occasionally is a middle-grade fever observed. The surface temperature of the legs feels colder than normal and thus the name. Sensation of the skin is dulled, especially over the paralyzed parts. In severe cases there is complete anesthesia of the whole body surface except over the head. Appetite and rumination are decreased and later entirely lost. Other rarer symptoms are retention or incontinence of urine, colic pains, bloody discharge from the anus, tremors of the muscles, and rigidity of the neck. The respiratory and circulatory systems are comparatively less affected. Consciousness is retained and excitement absent. The course of the disease is usually short, most animals dying within one to two days. The mortality rate is very high (probably over 95 per cent).

On post-mortem examination, the central nervous system is usually found to be highly congested. There may be hemorrhages under the meninges and petechiae in the spinal cord. The cut surface of the brain, however, looks apparently normal. Occasionally there is a gelatinous infiltration in the epidural space of the vertebral canal. Besides these changes in the nervous system there are always signs of septicemia of the whole body. Hemorrhages may be found in different organs. Constant and especially marked are hemorrhagic gastroenteritis, cystitis, tracheitis, and endocarditis, and occasionally effusions in the serous cavities. The parenchymatous organs show signs of albuminoid degeneration. Cultures taken from the blood and central nervous system are invariably negative.

Histological examination of the central nervous system reveals congestion and capillary hemorrhages in addition to the petechiae already visible to the naked eye. The nerve cells of the brain and spinal cord are mostly degenerated. The cytoplasm may be either swollen or, more often, shrunken so that the cells become irregular in contour. The nucleoli are masked by the deep staining of the pyknotic nuclei. In some cells there is complete dissolution of the nucleus and tigrolysis of the Nissl substance. The degenerated nerve cells are soon invaded by glial cells. This phenomenon of neuronophagia is especially marked in the pyramidal cells of the cerebral cortex and hippocampus, but less so in the Purkinje cells of the cerebellum and ganglion cells of the spinal cord. Perivascular spaces of the blood vessels of the brain are often dilated owing to an accumulation of edematous fluid. Adventitial proliferation is frequently seen, but perivascular infiltration is rarely encountered. There may be a mild degree of gliosis in the brain substance. Occasionally a small artery under the pia mater is thrombosed. Otherwise, the meninges are essentially negative. Inclusion bodies, whether intracytoplasmic or intranuclear, are not found.

In view of the facts stated above, the author believed this disease to be an encephalomyelitis caused by a filtrable virus. Experiments were soon planned and conducted to test its transmissibility to other animals. Brains and spinal cords of two buffaloes which had died of the disease were ground up in sterile normal saline and filtered through Seitz E. K. filters. The bacteria-free, clear filtrates were injected into goats, guinea pigs,



Optical Science Helps All Science

This is a picture of a pair of optical flats, showing the interference fringes discovered by Sir Isaac Newton. These fringes caused by the interference of the reflected rays of light from both contact surfaces, as seen through the optical flat or test glass, permit measurements accurate to 0.000002″. This optical principle is applied to the production of all Bausch & Lomb precision optical elements, from microscope objective lenses as small as a pinhead to giant telephoto lenses for aerial cameras. It is also used by science and industry as one of their most precise methods of measurement.

Through the application of such principles as this optical science is aiding all science in making this a better world in which to live. Bausch & Lomb Optical Co., 642 St. Paul St., Rochester 2, N. Y.

BAUSCH & LOMB

ESTABLISHED 1853

rabbits, pigeons, mice, a buffalo, and a sheep. Although the results in the sheep, mice, and pigeons were not sufficiently consistent to warrant a conclusion, the disease was found to be definitely transmissible to the rest of the experimental animals. A similar encephalomyelitis could be produced in the buffalo and goats by intravenous inoculation and in guinea pigs and rabbits by intracranial inoculation. Serial passage, however, was possible only for three generations in the guinea pig and two generations in the rabbit and goat. In the case of the buffalo, extensive experimentation was prohibited by its high cost, but judging from the typical symptoms and severe lesions produced in the only buffalo used, serial passage in this animal seemed to be easier than in any other host.

The incubation period among the experimental animals varied from 1 to 58 days and was shortest in the goat. The experimental disease in the buffalo resembled in every respect the natural infection. It developed suddenly on the twelfth day after injection, with subnormal temperature, paralysis of the legs, rigidity of the neck, and anesthesia of the body surface. The animal died about 14 hours after the onset of the symptoms. In the other animals, the course of the disease was even shorter, most of them dying within several hours. Invariably included among the symptoms were a lowering of the body temperature and a paralysis of the extremities. Upon histological examination, encephalomyelitic changes were always present. Cultures of the blood and central nervous system have never yielded any bacterial growth.

Attempts to cultivate the virus were not successful. Chick embryos of 8–10 days were inoculated on the allantoic membrane according to the method of Burnet. The birds seemed to be little affected by the virus and were hatched just as usual. Whether the titer of the virus had increased in the embryos was, however, not determined.

The disease seemed to be nontransmissible to human beings. In areas where the disease is prevalent, no human case has ever been reported. In our experimental work, the author and his assistants have never worn any rubber gloves or observed any other precautions, and yet none of us has ever contracted the disease.

Judging from its seasonal incidence, symptomatology, pathology, and infectivity to other animals, the author believes the disease to be a separate entity and different from all other known forms of encephalomyelitis. Further experimentation on the disease is still in progress, and a detailed report is in preparation.

T. S. SHENG, M.D., D.V.M.
Department of Animal Husbandry and Veterinary Medicine
National Central University, Chengtu, China

Book Reviews

Principles of physics III: optics. Francis Weston Sears. Cambridge, Mass.: Addison-Wesley Press, 1945. Pp. viii + 331. (Illustrated.)

The first course in physics at the Massachusetts Institute of Technology requires two years and is taken concurrently with analytical geometry and calculus. The result is that the present volume and the two earlier companion volumes of Sears' *Principles of physics* series, which serve as texts for this course, are far above the usual one-year elementary text in scope, rigor, and detail. Indeed, this book promises to be a competitor to the usual intermediate texts in optics, and will probably be considered in this connection by schools whose physics majors have not had the benefit of a first course as thorough as that at M.I.T.

It has much to recommend it. The unconscious technical slang and conventions of the usual textbook presentation are here carefully translated into operational meaning. Well-chosen plates (on color and on diffraction), and three-dimensional line drawings which have a rare feeling for space and projection, aid in setting a new standard in clarity of explanation. An attempt is made to justify qualitatively the few equations which cannot be derived by first-year calculus.

Much care was evidently spent in bringing the book up to date. The results are especially noteworthy in the chapters on Photometry and Color, which are better even than those of any current *intermediate* text, by virtue of the recent discussion and clarification in these areas. These two chapters on psychophysical units perhaps belong where they are, at the end of the book; but one may hope that optics, even in elementary courses, will some day be swallowed up by radiometrics, in which the quantities will all be measured in *physical* units, which can be then be discussed at the place where they belong in an exact science—that is, at the beginning of the course.

Some minor objections may be noted. Rigorous physicists will find fault with several equations which are dimensionally sloppy. Spectroscopists should protest against new texts which continue the emphasis on wave lengths rather than frequency or energy, but, of course, the author cannot be blamed for following the custom. Students will find difficult, as always, the unfamiliar thermodynamic point of view in the chapter on Thermal Radiation, as well as the unnecessary proliferation of units and symbols in Photometry and Color.

There are only a few mistakes. Several of them occur in the chapter on Polarization which, though good, seems less carefully written than the others. In particular, reflection and refraction are confused in discussing mirages and "looming." Fermat's principle of "extreme time" is restricted to "least time," thus making impossible the seeing of inverted images in a concave mirror! The false statement is made that the wave fronts in a biaxial crystal are ellipsoids.

On the whole, the book is one of the finest of elementary-intermediate texts now in the field and should be one of the easiest from which to teach, except perhaps for three or four less superior chapters out of the thirteen. The present volume suffers somewhat in attractiveness as a result of wartime paper restrictions.

JOHN R. PLATT

University of Chicago

The chemical process industries. R. Norris Shreve. New York: McGraw-Hill, 1945. Pp. xiii + 957. (Illustrated.) $6.00.

This is a most worthwhile reference text for all chemists, chemical engineers, chemical executives, chemistry and chemical engineering students, and others who are interested in an up-to-date and detailed account of the production methods for the manufacture of most of the more common chemicals and chemical products. Shreve's book is a welcome addition to our industrial chemical references, of which there are several excellent books of recent edition, for it brings together for the first time a closer relationship of the unit operations and unit processes involved with the actual industrial procedures. This is most essential for a better scientific and engineering understanding of these chemical processes.

The book is written from the viewpoint of the teacher and therefore serves well as a text for industrial chemistry courses. A discussion of the fundamental principles of chemical engineering as treated in a general way in the early chapters will provide the student with a better appreciation of the design, operation, and control features of the processes to be discussed later. Instead of arranging the processes in the usual order of sulfuric acid, phosphorus, soda, methyl alcohol, or aniline, the author covers these processes in a more logical fashion under groupings according to related manufacturing industries involving similar raw materials and chemical changes, such as fuels, ceramics, sodium salts, electrolytic products, paints, soaps, plastics, organic intermediates, etc. These are presented from an over-all standpoint to include the fundamental chemistry involved in the transformation of the raw materials into finished products, the process operations with specific conditions required, the essential design and construction features of the equipment, properties and industrial applications of the chemical products, and the economic aspects of the process. Interspersed with the descriptive material are many illustrations of the plant equipment as well as typical flow sheets of the processes which are of help in obtaining a clearer idea of the manufacturing methods. At the end of each chapter are problems and questions concerning the processes under discussion which enable the student or reader to determine in a practical way his mastery of these subjects.

There are few errors to be found in the text, which is a compliment to the author and aides for their careful collection of information, compilation of data, and painstaking presentation of intricate details of so many chemical processes. The only criticism to be offered by the reviewer is the reduced size of the flow sheets, which

NUTRITION
OF THE DOG

By Clive M. McCay
Professor of Nutrition, Cornell University

Combining in this book his study of the literature of nutrition with his practical experience as a kennel owner and consultant in the preparation of dog foods, Dr. McCay has written a guide for managers of kennels or owners of a single pet, as well as for veterinarians and research workers. Emphasis is placed on the carbohydrate, fat, protein, mineral and vitamin requirements of the dog and many formulas for feed mixtures are included. NUTRITION OF THE DOG is an excellent and authoritative summary of the information needed for the proper and economical feeding of dogs.

"NUTRITION OF THE DOG contains so much useful information so clearly presented that veterinary practitioners will recommend it as a helpful source of reference to all owners of dogs who seriously concern themselves with the subject."—*North American Veterinarian.*

"By far the most useful and understandable book that has been added to the library of the American Kennel Club in a long time." — *American Kennel Gazette*

140 pp., illustrated, $1.50

★

ORDER FROM YOUR BOOKSELLER OR

COMSTOCK PUBLISHING CO.
INCORPORATED
124 ROBERTS PLACE
ITHACA, NEW YORK

makes them difficult to follow. Also, the organic section, presented mainly in the last two chapters of the book, is considerably brief in many respects and might well have been expanded to include more specific information on these processes, in keeping with the importance of the synthetic organic chemical industry, which is fast assuming a major proportion of the whole chemical industry. The treatment of the organic processes is much below the fine standard of the remainder of the book.

James M. Church

Columbia University

War neuroses. Roy R. Grinker and John P. Spiegel. Philadelphia: Blakiston, 1945. Pp. ix + 145. $2.75.

This book was written in the military theater in Africa at the end of the Tunisian campaign and first published in September 1943 by the Josiah Macy, Jr. Foundation. Because of military restrictions it received limited distribution at that time—principally to medical officers in the Armed Services. In the present edition only a few deletions and minor revisions have been made.

The subject matter, facts, findings, and opinions are based on the authors' observation of patients with acute neurosis in both Ground Forces and Air Forces personnel of British and American troops. Nine clinical syndromes are described: (1) free-floating anxiety states, severe and mild; (2) somatic regressions; (3) psychosomatic visceral disturbances; (4) conversion states; (5) depressed states; (6) concussion states; (7) exhaustion states; (8) psychotic states; and (9) malingering. Each syndrome is illustrated by one case history or more. These are very brief and contain little in the way of personality evaluation. This is an understandable defect in view of the environmental situation under which the authors were working.

The types of therapy used were narcosynthesis with sodium pentothal, brief psychotherapy, convulsive shock therapy (with frenisol, a British equivalent of metrasol), continuous sleep, occupational therapy, group therapy, and general convalescent care. Emphasis is given to narcosynthesis, which is used to induce a seminarcose state during which the patient relives his traumatic combat experiences. The authors do not mention that many workers for some years have been using this general uncovering technique with sodium amytal with some success in both military and civilian neuroses and psychoses. Credit for such work goes to Bleckwenn, Horsley (England), Broder, Palmer, Braceland, and others. No credit should be withheld from Grinker or Spiegel, for they probably are the first American psychiatrists to use this type of treatment in World War II.

War neuroses is a dramatic presentation of tense life situations involving human emotions and body responses expressed in a time of unusual stress—a global war. Civilian psychiatrists and associated workers in the field should gain additional insight into the neuroses of war from this volume.

Addison M. Duval, M.D.

Saint Elizabeth's Hospital, Washington, D. C.

Scientific Book Register

Braymer, Daniel Harvey, and Roe, A. C. *Repair-shop diagrams and connecting tables for lap-wound induction motors.* New York: McGraw-Hill, 1946. Pp. 404. (Illustrated.) $5.00.

Delorme, Jean. *Le present et l'avenir des matières plastiques.* Grenoble: B. Arhaud. Pp. 300.

Gamow, George. *The birth and death of the sun; stellar evolution and subatomic energy.* New York: Penguin Books, 1946. Pp. 234. (Illustrated.) $.25.

Grant, Roy Llewellyn, and Tiffany, Joseph Edgar. *Detonators: initiating efficiency by the miniature-cartridge test.* (U. S. Bur. of Mines. Tech. Pap. 677.) Washington, D. C.: Government Printing Office, 1945. Pp. 38. (Illustrated.) $.10.

Markham, Edwin C., and Smith, Sherman E. *General chemistry problems: Form B.* Boston: Houghton, 1945. Pp. 196. (Illustrated.) $1.35.

Morgan, Frank Millet, and Breckenridge, W. E. *Solid geometry.* (Rev. ed.) Boston, Mass.: Houghton, 1946. Pp. 348. (Illustrated.) $1.48.

Verschaffelt, Ambroise Alexandre. *New iconography of the camellias.* (Trans. from the French by S. A. McIlhenny.) Avery Island, La.: Translator. Pp. 327. (Illustrated.) $3.50.

Waters, Charles A., *et al.* (Eds.) *1945 year book of radiology.* Chicago: Year Book Publishers, 1945. Pp. 464. (Illustrated.) $5.00.

Wheat, Harry Grove. *Studies in arithmetic; a summary of masters' problems and theses dealing with subject of arithmetic, West Virginia University, 1936–1944.* Morgantown: West Virginia Univ., 1945. Pp. 63. Gratis.

Woodruff, Asahel Davis. *The psychology of teaching.* New York: Longmans. Pp. 191. $1.75.

Young, Clarence Bernard Fehrer, and Coons, K. W. *Surface active agents.* Brooklyn, N. Y.: Chemical Publishing Co., 1945. Pp. 291. (Illustrated.) $6.00.

Zirkle, Conway. *The early history of the idea of the inheritance of acquired characters and of pangenesis.* (Transactions, Vol. 35, Pt. 2.) Philadelphia: American Philosophical Society, 1946. Pp. 91–151. $1.25.

Zworykin, Vladimir Kosma, *et al.* *Electron optics and the electron microscope.* New York: Wiley, 1945. Pp. 777. $10.00.

————. *Anales del Museo Argentino de Ciencias Naturales, "Bernardino Rivadavia."* (Tomo XLI.) Buenos Aires: Imprenta de la Universidad, 1943–1945. Pp. vii + 479. (Illustrated.)

————. *Tables of food composition in terms of eleven nutrients.* Prepared by Bureau of Human Nutrition and Home Economics, U. S. Dept. of Agric., in cooperation with National Research Council. (U. S. Dept. of Agric., Misc. Publ. No. 572.) Washington, D. C.: Government Printing Office, 1945.

SCIENCE

Vol. 103, No. 2673 Friday, March 22, 1946

Can We Curb the Irresponsibles?

Lawrence K. Frank, *Chairman*

Committee on Science and Society, AAAS

THE TRIAL OF THE WAR CRIMINALS in Germany is an event of major significance, going far beyond the punishment of those who ordered or committed atrocities. It marks the first formal step toward fixing responsibility upon military men for deliberately planning to make war and to conquer, subjugate, and destroy other nations. It has a direct bearing upon the scientists today.

This is indeed a step with far-reaching consequences, for it boldly approaches the basic problem of curbing the irresponsibles, especially those with the immense power and military authority for making war who can control armies, navies, and air force, and also the full resources, human and natural, of a nation. These are the individuals who wantonly and irresponsibly plot to invade their neighbors, devastate open cities, and unleash death and misery upon the world.

Heretofore the generals and admirals and their staffs, when and as they decided it was necessary or would be safe and advantageous to their country, planned and waged war. They were privileged and protected by the fiction that they were patriotically obeying the orders of their country, which they obediently served, even though it was evident that they had long planned the war and carefully provoked the incidents that started hostilities.

Now, thanks largely to the vision and courage of Justice Robert Jackson, the trial of war criminals moves forward to the unprecedented position of accusing the military and naval leaders of Germany of deliberately plotting war and planning for conquest. They are therefore being tried as war criminals by the International Court at Nürnberg while the lesser command are being tried elsewhere for atrocities and almost unbelievable cruelties inflicted upon helpless, unarmed people and apparently ordered by the higher command.

The Principle of Responsibility

This trial and the fully documented accusations are based upon the principle, now clearly enunciated and applied for the first time, that the exercise of irresponsible military and naval power is a criminal offense *against world order*—not international law.[1] Any defense they may offer of obeying orders like good, patriotic soldiers, will be stopped by this principle of personal responsibility for exercise of the supreme power they enjoyed and of accountability for using that power to break the peace and disrupt world order deliberately.

It is worth recalling that in earlier centuries, before the rise of the national state, the smaller units of territory in Europe were held by feudal lords who were at once the rulers and also the military leaders of their lands. A lord organized, directed, and led his men at arms, either in defending his land or in attacking others' land. They were involved in an intricate web of feudal relationships in which they were often called upon to help another lord or were themselves aided by another. If defeated, they might call for assistance from their feudal allies or enter into a new alliance with someone who could protect them. But often defeat meant paying the penalty, personally, of losing their land, their stronghold, and even their life. Responsibility and accountability were real, immediate, and inescapable since they had no convenient excuse for obeying orders or being patriotic.

When, however, the professional soldier and sailor began to appear with the rise of the national state, they emerged from this older tradition, retaining the protocol of rights and privileges and honors, but becoming—to speak plainly—hired fighters, however dignified, honorific, and patriotic they claimed to be.

Professional soldiers and sailors at the top ranks thus evolved into a specialized caste, proud and often arrogant in their rank, prestige, and power. Academies arose to train these specialized men, to indoctrinate them with the traditions and protocol, as we see in our own Navy personnel, and to foster their professional careers. They often languished during the times of peace, but flourished during war, after each of which they accumulated more power and authority in the nation, as the history of Europe shows.

---

[1] The plea, strongly urged by some in this country, that this is *ex post facto* law, an attempt to convict individuals as criminals for acts which heretofore were not so declared, must also be denied. The prohibition of *ex post facto* laws is a highly desirable, indeed essential, protection of civil liberties in an individual country, but in international affairs it does not have the same claim to validity. Aggressive acts by one nation against others cannot be construed as a right or power to be enjoyed until formally declared illegal. Nor can the individuals who made the plans and decisions for aggressive warfare take refuge in the law of agency, since they were principals before they became agents of war making.

Planning for the next war, including full utilization of national resources, became the accepted national practice, with a general staff continuously engaged in making strategic plans and conducting maneuvers, designing and testing new weapons, and preparing their forces for action. These professionals, *win or lose,* enjoyed their rank and privileges and their irresponsibility. In every large country today, professional military and naval men now exercise these enormous powers with weapons of unprecedented power of destruction, now enlarged by the atomic bomb. They are no longer just *agents* of the national government: they are now the principals who can and do determine policies and make the decisions that commit the whole nation to aggressive warfare and conquest. To permit these individuals to continue their irresponsible careers of deliberately planning, and thereby often provoking, war has become intolerable.

It is clear that the United Nations Organization, made up of representatives of the several national states, will be at the mercy of these irresponsible military men especially in those countries where they can, and do, dictate national policies and international relations. If this attempt to establish some form of world wide organization for maintaining peace is to function more effectively than the League of Nations, these irresponsible and often ruthless military leaders must be made accountable and brought under some effective world control.

The Nürnberg trial, therefore, is the first attempt to curb these irresponsible individuals in the interest of establishing world order and limiting militarism, with its conscription of man and woman power and mobilization of all national income and resources for total war.

The military and naval men outside of Germany are not happy over this trial since it strikes at their traditional privileges and threatens to deprive them of their irresponsible power by denying them the protection of the time-honored pleas of obeying orders and being patriotic.

Yet this doctrine of responsibility cannot be limited to the army and navy high command. It is clear that in Germany the owners and managers of large heavy industry and of technical works worked closely with the General Staff to plot and prepare for war and to wage war. Likewise, the financial groups were equally involved in this plotting and did their full share to expedite the all-out war effort and the looting of conquered countries.

Once this principle is established there is no valid reason for not extending it to all the warmongers, the writers and publicists, legislators, and indeed all those who publicly demand war against any nation they dislike or wish to despoil, or who surreptitiously foment war.

SCIENTISTS AND THE PRINCIPLE OF RESPONSIBILITY

Thus, we must ask about extending this principle to the scientists, since it is clear that through research and experimental applications (such as bombs and rockets and radar) they are now the key group in planning and preparing for war. The atomic bomb has made this plainly evident and thereby has clarified the basic issue of responsibility as nothing else has done. The scientists themselves have been shocked into an awareness of their new role and their worldwide responsibilities. Never before have scientists, as a specialized group, been deliberately organized to wage war as they have done during World War II and, now, to prepare for the next war as provided in the National Defense Research Board, set up by the National Academy of Sciences, with the collaboration of the Army and Navy. *If the scientists are to succeed the generals and admirals and take over some or all of the functions of the General Staff, are they to enjoy the irresponsibility of the professional soldier and claim the traditional protection of being obedient, patriotic agent-citizens serving their country?*

This is the crucial question now being discussed by scientists, especially in the United States. Many of the atomic or nuclear physicists, especially the younger men, have become fully aware of this issue and apparently are prepared to take action as a responsible, accountable group. Others are calling for a new world government, apparently as a plea in avoidance, because they will not, or cannot, accept the immense responsibility that goes with the great power of their new knowledge and techniques.

Recently the proposal has been made (*Science,* 1945, **102,** 672) that the scientists themselves come together from all lands to form a world association of physicists who will agree among themselves, as scientists, with a full awareness of their unique position, to keep the peace by refusing to lend their knowledge to the making of atomic bombs. (Also see, *Science,* 1946, **103,** 158–160.)

If the scientists who, by profession and tradition, are dedicated to disinterested, impersonal research, and who have long accepted the internationality of science, will accept this professional responsibility, then we can begin to arraign all the others who are irresponsible in their several fields—the political leaders and legislators, newspaper owners and columnists, and commentators; the international manipulators of economic affairs, the cartelists; indeed, all those who are now privileged, as individuals and in groups, to provoke and to contrive war and otherwise to disturb peace.

No nation, as Edmund Burke told us, can be indicted, but we can and must fix responsibility upon the individuals who, in positions of power and authority—military, naval, economic, and financial (and now scientific)—are the active principals and directors of the national, monolithic, aggressive state. If there is to be atomic warfare, it will come by the plans and decisions of specific individuals who have deliberately calculated their preparation and use upon specific targets. If we will accept the principle of accountability, these can be identified and legally tried and convicted for their individual and joint acts, just as the leaders of a mob can be tried and convicted for arousing and directing mob action. A firm declaration of this policy and application of this rule may offer what the many paper schemes of control and inspection are vainly seeking to achieve for controlling atomic bombs.

Curbing these irresponsibles is not a revolutionary act. It is the continuation of our legal traditions which, over the centuries, have recognized the principle of accountability for actions injurious to others. Just as in the early days of Anglo-Saxon jurisprudence the principle of individual accountability had to be wrought out and then painfully established, to replace the ancient doctrine of group responsibility, so today we face an equally momentous step, of fixing responsibility upon individuals for the disturbance of peace and world order. Today we can now assert and prove that these specific individuals, *with intent,* plotted and planned the war in which they used their nation and its sovereignty for deliberate aggression.

If we can make this clear, perhaps we can enlist the men and women of good will the world over in supporting this first concrete action for establishing the responsible conduct necessary for world order, the indispensable condition for the effective operation of the United Nations Organization or any world state.

Justice Robert H. Jackson's opening statement for the United States, the complete text of the indictment, and the text of the four-power agreement on which the Nürnberg trials are based will be found in Robert H. Jackson, *The case against the Nazi war criminals,* Alfred A. Knopf, N. Y. 1946.

"I Got Previous Experience With This Stuff"

MILITARY AUTHORITY
DESTRUCTION OF THE CYCLOTRONS IN JAPAN, 5 MONTHS AFTER THE WAR
ATOMIC SCIENCE

From *The Washington Post* 13 March 1946

Technical Papers

Hemolytic Streptococcal Sore Throat: Antibody Response Following Treatment With Penicillin, Sulfadiazine, and Salicylates[1]

Lowell A. Rantz, *Stanford University Hospital, San Francisco*; Paul J. Boisvert, *New Haven Hospital*; and Wesley W. Spink, *University Hospital, Minneapolis*

Information has recently been obtained during a field study with regard to the formation of antistreptolysin and antifibrinolysin following acute Group A hemolytic streptococcal sore throat in military personnel. A complete description of the relationship of these and other streptococcal antibodies to the observed clinical phenomena will be presented elsewhere. Many of the infected individuals were treated by the administration of penicillin, sulfadiazine, or salicylates. Because of the great interest in chemo- and antibiotic therapy, it seemed desirable to present immediately the results of this study in so far as it bears on antibody response in treated and untreated cases.

Sera were obtained on approximately the third and twenty-first days from 351 cases of acute Group A hemolytic streptococcal sore throat. The diagnosis was made on clinical and bacteriological grounds. The exact criteria and techniques will be described elsewhere. The antistreptolysin titers were determined by a modification of the usual technique (*5*). Antifibrinolysin titers were also measured at similar intervals in 321 cases (*1*).

Two hundred and thirty-three cases received no treatment except hot saline gargles. Chemo- or antibiotic therapy was begun in the others on the second or third day of the acute illness and continued according to the following schedules:

Salicylates: 10 grams of sodium salicylate were administered by mouth each day for approximately one week.

Sulfadiazine: 4 grams of sulfadiazine were administered by mouth as an initial dose, followed by 1 gram every four hours, day and night. The average total dose for the group was 39 grams and the duration of therapy 6.5 days.

Penicillin followed by sulfadiazine: 200,000 units of penicillin were administered intramuscularly in 18 to 24 hours, the individual injections being given at intervals of four hours. A standard oral course of sulfadiazine was begun with the last dose of penicillin, an average of 33 grams being given in 5.8 days.

Penicillin—short course: 200,000 to 400,000 units of penicillin were administered intramuscularly, at four-hour intervals in from 32 to 64 hours.

Penicillin—long course: 500,000 or 1,000,000 units of penicillin were administered intramuscularly at four-hour intervals in 80 hours.

Hemolytic streptococci usually disappeared from the throat during the exhibition of penicillin but frequently returned when the agent was withdrawn. At this time a clinical relapse often was observed.

The results of this study are included in Table 1. A 50-per cent increase in the antistreptolysin titer or a prolongation of clot lysis of more than eight hours were regarded as measures of significant antibody response.

TABLE 1

ANTISTREPTOLYSIN AND ANTIFIBRINOLYSIN RESPONSE IN ACUTE GROUP A HEMOLYTIC STREPTOCOCCAL SORE THROAT TREATED WITH VARIOUS CHEMICALS

Treatment	No. of cases	No. with bacteriological relapse	No. with clinical relapse	Antistreptolysin				Antifibrinolysin		
				No. of cases	Cases with antibody response	Per cent with antibody response	Mean increase titer units	No. of cases	Cases with antibody response	Per cent with antibody response
Salicylates	25	..	..	25	22	88.0	477	25	10	40.0
Sulfadiazine	36	..	..	36	30	83.3	327	31	15	48.5
Penicillin and sulfadiazine	25	20	9	25	22	88.0	268	25	8	32.0
Penicillin—short course	16	16	8	16	14	87.5	442	16	7	43.5
Penicillin—*long course* Bacteriological relapse	7	7	4	7	7	100.0	241	7	1	14.0
Penicillin—long course No bacteriological relapse	9	0	0	9	4	44.5	182	9	1	11.1
None	233	..	..	233	190	81.6	204	208	73	35.1

---

[1] This investigation was carried out during a field study by the Commission on Hemolytic Streptococcal Infections, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Service, Office of the Surgeon General, U. S. Army. The laboratories of the Department of Medicine, Stanford University School of Medicine, San Francisco, were made available to the Commission for certain studies.

None of the therapeutic procedures prevented the formation of antistreptolysin or antifibrinolysin. The administration of salicylates, sulfadiazine, and/or a short course of penicillin failed to diminish the percentage of individuals exhibiting an antibody response, or the mean increase in antistreptolysin. The latter was greater in certain treated groups than in the controls. This result is probably not significant for the reasons stated below.

When penicillin was administered over a longer interval, the frequency of the antifibrinolysin response was decreased. An antistreptolysin response was also observed less often in those individuals in whom bacteriological relapse did not occur.

These latter observations suggest that the exhibition of penicillin in amounts adequate for the elimination of the hemolytic streptococcus from the throat may interfere with the formation of these antibodies. It is necessary to be very guarded in reaching such a conclusion based upon the study of small groups of individuals infected by a variety of types of Group A streptococci, since it has been demonstrated that the different types vary in their ability to stimulate the production of antistreptolysin (*4*) and antifibrinolysin (*2, 4*), and that great individual differences exist between various human beings in their ability to react to the antigenic stimulus of infection by these organisms (*3*).

References

1. Boisvert, P. J. *J. clin. Invest.*, 1940, 19, 65.
2. Commission on Acute Respiratory Diseases, in collaboration with Melvin Kaplan. *Science*, 1945, 101, 120–122.
3. Rantz, L. A. *Arch. int. Med.*, 1944, 73, 238.
4. Rantz, L. A., Boisvert, P. J., and Spink, W. W. (To be published.)
5. Rantz, L. A., and Randall, E. *Proc. Soc. exp. Biol. Med.*, 1945, 59, 22.

Blood Levels of Penicillin After Oral Administration With Various Antacids

Lloyd D. Seager

Department of Pharmacology, Woman's Medical College of Pennsylvania

Many antacids have been employed with apparent success (*2, 3, 5, 6, 7, 12*) in an attempt to protect penicillin from destruction when given orally. Considerable discrepancy appears in the results reported, and it was felt that a comparison of the effectiveness of various antacids in a group of normal adults would be desirable. Though there may be considerable variation in gastric acidity from time to time in the same individual, comparative studies made largely on the same group of individuals, under stated conditions, should be more valid than those made on different groups with a variety of illnesses.

Methods

Subjects were allowed to have a soft diet, low in protein and fat. They were given 100,000 units of calcium penicillin along with the equivalent of 2.5 grams of one of the antacids. Aluminum hydroxide, magnesium trisilicate, and magnesium hydroxide were given as magmas or gels. The penicillin was freshly mixed with these preparations before use according to the method of Welch (*12*). Trisodium citrate and aluminum dihydroxy amino acetate were used in tablet form with penicillin incorporated in them. Seven control tests were made with penicillin administered in tap water, and in one case it was given in tap water to a pernicious anemia patient. Blood samples were obtained at hourly intervals for 4 hours, and urines were collected up to 6–12 hours. Blood levels of penicillin were determined by the Fleming Slide cell method (*4*) and urine concentrations by the Oxford cup method (*1*).

TABLE 1

Blood Levels of Penicillin After the Oral Administration of 100,000 Units of Calcium Penicillin in Tap Water

Subject	½ hr.	1 hr.	1½ hrs.	2 hrs.	3 hrs.	4 hrs.	Per cent excretion
*S	...	0.06	0.03	0	0	...	6.6
*S	...	.12	...	.08	0	...	....
*W	.12	.12	...	.06	0	...	15.9
†S	0	0	0	0	...	...	1.9
†W	...	0	0	0	0	...	1.5
†S	...	.12	0	0	0	...	1.25
†W	.08	0	0	0	0	...	0.48
‡R	...	0.24	...	...	0.24	0.03	24.2

* Empty stomach.
† Full stomach.
‡ Pernicious anemia.

TABLE 2

Blood Levels of Penicillin After Oral Administration With 100,000 Units of Calcium Penicillin in Aluminum Hydroxide Gel

Subject	1 hr.	2 hrs.	3 hrs.	4 hrs.
K	0	0.06	0.015	0.015
L	0.08	0.015	0.015	0
R	0.12	0.06	....	0
F	0.12	0.08	0.08	0
W	0.24	0.12	0.015	....
G	0.08	0.03	0.03	0.03
ST	0.24	0.24	0.06	0
Average	0.11	0.079	0.03	0.007

Results

Of the tap water controls (Table 1) these tests were made with 100,000 units on an empty stomach, and four tests were made on the same subject after a full meal. Penicillin levels were present up to one and a half to two hours when given on an empty stomach, but in only one instance was the drug demonstrable in the blood at the end of one hour when given on a full stomach. Penicillin was demonstrable in the urine as early as three minutes after administration. When given on an empty stomach the excretion varied from 6.6 to 15.9 per cent. When given on a full stomach the excretion varied from 0.48 per cent to 1.9 per cent. A pernicious anemia patient given 100,000 units orally in tap water showed a blood level of 0.24 units/cc. up to three hours and a level of 0.03 at four hours. Excretion in the urine was 24.2 per cent.

TABLE 3

BLOOD LEVELS OF PENICILLIN AFTER ORAL ADMINISTRATION OF 100,000 UNITS OF CALCIUM PENICILLIN WITH MAGNESIUM TRISILICATE

Subject	1 hr.	2 hrs.	3 hrs.	4 hrs.
G	0.03	0.06	0.015	0
W	0.12	0.03	0.015	0
S	0.24	0.06	0.06	0.03
ST	0.24	0.03	0.03	0.03
C	0.24	0.03	0	0
Average	0.175	0.042	0.024	0.012

TABLE 4

BLOOD LEVELS OF PENICILLIN AFTER ORAL ADMINISTRATION OF 100,000 UNITS OF CALCIUM PENICILLIN WITH TRISODIUM CITRATE

Subject	1 hr.	2 hrs.	3 hrs.	4 hrs.
F	0.12	0.12	0.06	....
R	0.48	0.24	0.06	0
ST	0.12	0.06	0.015	0.015
C	0.12	0.12	0.015	0.015
F	0.12	0.06	0.015	0.03
S	0.06	0.06	0.015	0.015
Average	0.17	0.11	0.03	0.018

Blood levels for the five antacids studied are shown in Tables 2, 3, 4, 5, and 6. It is obvious that all the antacids gave striking increases in blood levels of penicillin as compared to the tap water controls. The highest average levels at the end of the first hour were with trisodium citrate and magnesium trisilicate. The highest average levels at the end of the second and third hours were with aluminum dihydroxy amino acetate. The highest levels at the end of four hours were with trisodium citrate and aluminum dihydroxy amino acetate. This may be correlated with the fact that these two preparations were given in tablet form. The lowest results were obtained with milk of magnesia. The differences with the other antacids employed were not striking.

In two experiments calcium penicillin was adsorbed on aluminum hydroxide according to the method reported by Welch (*12*) and was given on an empty stomach in doses of 25,000 units every two hours for four doses. Blood and urine samples were taken hourly for seven hours. Urine collections continued at intervals up to 24 hours. No penicillin was demonstrated in the blood at any time by our method, and only traces appeared in the urine after nine hours. One subject given an initial dose of 50,000 units of this preparation followed by 25,000 units every hour for four hours showed hourly blood levels of 0.06, 0.12, 0.24, 0.12, 0.12, and 0.03. The excretion was 10.3 per cent.

TABLE 5

BLOOD LEVELS AFTER THE ORAL ADMINISTRATION OF 100,000 UNITS OF CALCIUM PENICILLIN WITH ALUMINUM DIHYDROXY AMINO ACETATE

Subject	1 hr.	2 hrs.	3 hrs.	4 hrs.
W	0.06	0.03	0.03	0
S	0	0.12	0.06	0.03
H	0.24	0.12	0.06	0.03
J	0.24	0.24	0.03	0
B	0.12	0.24	0.03	0
S	0.06	0.03	0.03	0
A	0.12	0.24	0.06	0.06
Average	0.12	0.14	0.043	0.017

TABLE 6

BLOOD LEVELS OF PENICILLIN FOLLOWING THE ADMINISTRATION OF 100,000 UNITS OF CALCIUM PENICILLIN WITH MILK OF MAGNESIA

Subject	1 hr.	2 hrs.	3 hrs.	4 hrs.
ST	0.06	0.03	0	0
S	0.24	0.24	0.12	0
ST	0.03	0.015	0	0
K	0.24	0.03	0	0

DISCUSSION AND SUMMARY

The five antacids used orally with penicillin in this study showed marked effects in maintaining the blood levels of the drug. With the exception of milk of magnesia, there were no striking differences with the various antacids. In no instance were the blood levels maintained as well as in the pernicious anemia patient who received the drug in tap water alone. Results with antacids are similar to the results obtained with the administration of penicillin in enteric coated capsules (*10, 11*), but the levels are far inferior to those obtained by the intravenous drip (*8*) or intramuscular administration in oil (*9*). It is apparent that maximum efficiency for the oral administration has not been attained.

Confirmation is lacking in my results of the prolonged blood levels of penicillin, as reported by Welch (*12*) when given in single or in divided doses with aluminum hydroxide gel.

References

1. Abraham, E. P., *et al.* *Lancet*, 1941, **2**, 177.
2. Burke, F. G., *et al.* *J. Amer. med. Ass.*, 1945, **128**, 83.
3. Charney, J., *et al.* *Science*, 1945, **101**, 251.
4. Fleming, Alexander. *Lancet*, 1943, **2**, 434.
5. György, P., *et al.* *J. Amer. med. Ass.*, 1945, **127**, 689.
6. Little, C. J., and Lumb, G. *Lancet*, 1945, **1**, 203.
7. Paul, W. D., *et al.* *J. Iowa med. Soc.*, 1945, **35**, 219.
8. Ratz, L. A., *et al.* *J. clin. Invest.*, 1944, **23**, 789.
9. Romansky, M. J., and Rittman, G. E. *Science*, 1944, **100**, 196.
10. Seager, *et al.* (To be published.)
11. Shoemaker, W. G., and Seager, L. D. *Amer. prof. Pharm.*, 1945, **2**, 618.
12. Welch, H., *et al.* *J. Amer. med. Ass.*, 1945, **128**, 845.

Studies on the Toxicity of Streptomycin for Man: A Preliminary Report[1]

Robert A. Hettig and John D. Adcock

University of Michigan, Ann Arbor

The advent of a new therapeutic agent, such as streptomycin (*4*), inevitably arouses curiosity about its efficacy on the one hand and about its potential and actual toxicity on the other. The parenteral administration of streptomycin to susceptible laboratory animals has produced fatty metamorphoses in the parenchymal cells of the liver and to a lesser extent in the tubular epithelium of the kidneys. These histological changes, which have been demonstrated by Mushett (*3*) are reversible and disappear rapidly after the drug is discontinued. Since both crude and crystalline streptomycin preparations produce these changes readily, their appearance must be attributed to a toxic property intrinsic in the antibiotic itself. Because of the lesions demonstrated in the viscera of experimental animals, the authors have attempted to evaluate the effect of parenteral streptomycin on the renal, hepatic, and hematologic functions of man. In the course of these experiments some clinical reactions have been encountered and will be discussed below.

Nine patients, whose ages ranged from 15 to 61 years, served as subjects. The total dosages of streptomycin varied from 1,850,000 units administered over a period of 48 hours to 72,250,000 units given over a period of 56 days. Six of the nine patients received the antibiotic by intermittent intramuscular injections at 3- or 4-hour intervals. Two patients were given the drug by continuous intravenous infusion and one patient by continuous hypodermoclysis. One patient also received 40,000,000 units of streptomycin orally over a period of 11 days in addition to that administered parenterally. The following tests were performed just prior to beginning streptomycin and were repeated within 96 hours following termination of the administration: urea clearance, bromsulfalein, retention, cephalin cholesterol flocculation, and complete blood counts, including differential leucocyte counts. In addition, urinalyses were done at frequent intervals before, during, and following the experimental trial.

The results of these laboratory tests have been compiled in Table 1 together with the doses of streptomycin and the duration of administration. No impairment of hepatic or renal function was detected by the serial bromsulfalein, cephalin cholesterol flocculation, and urea clearance studies. The urines of two subjects (J.P. and I.S.) exhibited abnormalities of the formed elements during the experimental period. On the eighth day of streptomycin administration J.P. developed a microscopic hematuria which subsided a few days after the drug was discontinued. I.S. became intolerant of the antibiotic on the eleventh day of administration, as manifested by fever and arthralgia. At this time a slight albuminuria was noted, and the urinary sediment contained numerous hyaline and finely granular casts. These abnormalities persisted for 72 hours after the drug was discontinued and were no longer apparent when the formal post-streptomycin evaluation was conducted 96 hours after the conclusion of the experimental trial.

Since no significant decrease of the hemoglobin or erythrocyte levels was encountered in any case, it would appear that in these experiments streptomycin exerted no suppressive effect on erythropoiesis and produced no hemolytic reaction. The total and differential leucocyte counts of eight subjects exhibited no unexpected abnormalities. In the case of C.F., however, a leucopenia of 3,550 cells per cubic millimeter and a neutropenia of 48 per cent were detected at the termination of a 45-day trial. This depression of leucocytes persisted for only a few days, after which the white cell values returned to normal range.

Two additional patients, both desperately ill of tuberculous meningitis, received parenteral streptomycin. Since their precarious condition did not permit formal toxicity studies, the clinical data of these patients are not included in Table 1. One of these patients died after 7,000,000 units of the drug had been administered by continuous hypodermoclysis over a period of 3 days and the second patient expired after receiving 15,000,000 units by similar route over a period of approximately 4 days. Post-mortem histological examination of the liver and kidneys revealed no lesions which could be attributed to the action of streptomycin.

Although no evidence of serious organ toxicity has been demonstrated, undesirable reactions have occurred with the relatively crude preparations of strep-

---

[1] These studies were aided by grants from the executive board and board of governors of the Horace H. Rackham School for Graduate Study of the University of Michigan. The streptomycin used in these studies was furnished by Merck and Company, Inc., Rahway, New Jersey. The material was supplied as a dry powder of varying degrees of purity, the active principle being present as the hydrochloride.

TABLE 1

RESULTS OF STUDIES ON RENAL, HEPATIC, AND HEMATOPOIETIC FUNCTION BEFORE AND FOLLOWING STREPTOMYCIN

		Clinical data			Blood values			Renal studies				Liver function		Comments
Patient	Diagnosis	Units of streptomycin administered and route	Duration of administration	Relation of values to administration	Hgb. in grams/100 cc.	RBC in millions per cmm.	WBC per cmm.	Urine albumin	Urine sediment	Urea clearance		Cephalin cholesterol flocculation	Bromsulfalein (% retained)	
										1st hr.	2nd hr.			
R.S.	Urinary tract infection	1,850,000 I.M.	2 days	Before	16.6	4.7	10,350	1 plus	Many WBC	140%	96%	Neg.	0	Arthralgia, fever
				After	17.2	4.9	10,200	Neg.	0 WBC	100%	128%	Neg.	0	
J.H.	Urinary tract infection	3,000,000 I.M.	3 days	Before	15.5	4.4	5,500	1 plus	Many WBC	117%	125%	Neg.	0	Skin eruption
				After	16.5	4.8	7,200	Trace	Occ. WBC	119%	94%	Neg.	0	
E.J.	Urinary tract infection	4,000,000 I.M.	4 days	Before	12.8	5.1	7,700	Neg.	Many WBC	77%	56%	Neg.	5	
				After	13.7	4.3	8,800	Trace	Many WBC	57%	80%	Neg.	5	
I.B.	Urinary tract infection	5,000,000 I.V.	4 days	Before	10.9	4.8	12,000	Trace	Many WBC	80%	69%	Neg.	5	Skin eruption Low-grade fever
				After	12.0	5.0	7,500	Neg.	Occ. WBC	100%	70%	Neg.	5	
I.S.	Carrier Salmonella	16,000,000 S.C. 40,000,000 P.O.	11 days	Before	14.0	4.7	5,100	Neg.	Occ. WBC	85%	87%	Neg.	0	Severe arthralgia Low-grade fever
				After	13.7	4.4	6,650	Neg.	Occ. WBC	91%	98%	1 plus	0	
C.J.	Urinary tract infection	18,000,000 I.M.	9 days	Before	15.4	5.0	6,050	Neg.	Many WBC	49%	77%	Neg.	5	Histamine-like reactions
				After	15.2	5.3	6,800	Trace	Occ. WBC	60%	78%	1 plus	5	
J.P.	Pemphigus	20,000,000 I.V.	8 days	Before	12.2	4.0	11,800	1 plus	Occ. WBC	109%	82%	3 plus	15	Chill and fever of 105.5°
				After	12.0	4.2	11,400	Trace	40 RBC	105%	77%	3 plus	0	
C.F.	Tuberculous adenitis	41,250,000 I.M.	45 days	Before	11.9	3.6	6,300	Neg.	Occ. WBC	125%	117%	2 plus	10	
				After	14.5	4.4	3,550	Neg.	Occ. WBC	98%	72%	3 plus	0	
V.S.	Pulmonary tuberculosis	72,250,000 I.M.	56 days	Before	13.3	4.4	14,150	Neg.	Neg.	83%	72%	1 plus	0	Mild arthralgia Histamine-like reaction
				After	15.4	5.3	6,800	Neg.	Neg.	143%	100%	Neg.	0	

I.V. = continuous intravenous infusion. I.M. = intramuscular injection. S.C. = continuous hypodermoclysis. P.O. = oral administration.

tomycin employed in these studies. These reactions varied in frequency and severity with different lots of the material and were encountered more frequently in the earlier less refined lots than in the more recent preparations. Such undesirable effects can, we believe, be attributed to impurities rather than to the antibiotic itself.

The reactions were of two main varieties. The first was characterized by facial flushing, headache, and fall of blood pressure, and resembled the classical response to histamine. It appeared promptly following intravenous or intramuscular administration and lasted from 10 to 60 minutes. This histamine-like reaction was noted in three of the several lots which were tested, and when these same lots of streptomycin were given to experimental animals, Molitor (*2*) was able to demonstrate a similar effect.

The second type of reaction consisted of fever, invariably accompanied by myalgias and arthralgias particularly in the temporomandibular joints and suboccipital region. These symptoms appeared only after streptomycin had been given for a period of time, varying from 24 hours to several days. In this series of observations no clinical evidence of eighth-nerve toxicity was encountered. Hinshaw and Feldman (*1*) recently reported such toxic reactions in 3 of 34 patients who received streptomycin for considerable periods of time.

Skin eruptions appeared in two subjects on the third day of the experimental period. The rash of subject I.B. resembled erythema nodosum and was undoubtedly due to streptomycin. The clinical significance of the maculopapular exanthem of subject J.H. could not be satisfactorily evaluated because he had received pentobarbital concomitantly.

Local reactions, consisting of pain and tenderness at the site of intramuscular or subcutaneous injections, were related to the amount of impurities retained in the preparations used, less difficulty being encountered with the more refined lots of the antibiotic. These local effects were never severe enough to interfere with continued drug administration and could be alleviated by the local application of heat.

Further experience will be required to define the possible toxic effects of prolonged therapy with streptomycin. It is planned to extend these studies when sufficient supplies of this antibiotic are available for clinical investigation.

SUMMARY

In this limited experience, tests of renal and hepatic function together with blood studies before and after the parenteral administration of streptomycin revealed no evidence of serious toxicity. Reactions, consisting of fever, arthralgias, and skin rashes as well as histamine-like effects, are believed to be due to impurities retained in the preparations of streptomycin employed in these studies.

References

1. Hinshaw, H. C., and Feldman, W. H. *Proc. Staff Meet., Mayo Clin.*, September 5, 1945, 20, 313–318.
2. Molitor, H. Personal communication.
3. Mushett, C. W. Personal communication.
4. Schatz, A., Bugie, E., and Waksman, S. A. *Proc. Soc. exp. Biol. Med.*, 1944, 55, 66–69.

Complement-fixing and Neutralizing Antibodies Against Japanese B Virus in the Sera of Okinawan Horses[1]

Lt. Horace L. Hodes, Lt. Cdr. Lewis Thomas, and
Lt. John L. Peck (MC, USNR)
U. S. Naval Medical Research Unit No. 2
Guam, Marianas

Early in July 1945, an outbreak of encephalitis appeared among natives of Okinawa. The disease, which eventually affected a number of American service men on the island as well as natives, continued to occur during August and early September. We have recently reported (*2*) that Japanese B encephalitis virus was the cause of the outbreak. This conclusion was reached by the demonstration of the development of a significant titer of complement-fixing antibodies against this active agent in the sera of convalescent patients and by the isolation, from the brain of a patient dying of encephalitis, of an active agent which was identified by specific complement-fixation and neutralization reactions as Japanese B virus.

It is known that horses are susceptible to several kinds of encephalitis. In view of this fact, evidence was sought regarding the role that horses played in the outbreak of encephalitis in Okinawa. Accordingly, sera, collected in mid-August from nine Okinawan horses in areas where encephalitis was present among human beings, were tested for complement-fixing antibodies (*1*) against antigens prepared from the viruses of Japanese B, Western equine, and Eastern equine encephalitis. Sera of five Okinawan goats from the same areas and serum obtained on Guam from a normal horse were also tested. All sera obtained from the Okinawan horses fixed complement in the presence of Japanese B virus in a final dilution of 1:16 or greater (a 2+ reaction in a dilution of 1:8 or higher is significant). The serum of one horse yielded a titer of 1:128; two, a titer of 1:64; three, a titer of 1: 32; and three, a titer of 1: 16. All these sera failed to fix complement to a significant degree when tested against Western equine encephalitis virus; three of the sera also gave negative results with Eastern equine encephalitis virus. Sera of five Okinawan goats failed to fix complement in the presence of Japanese B or Western equine encephalitis virus; sera of two of these animals also gave negative results with Eastern equine encephalitis virus. Serum of the normal Guamanian horse contained no complement-fixing antibodies against any of the three virus antigens employed. The results of the complement-fixation tests indicate that all nine Okinawan horses tested had had some previous contact with Japanese B virus.

---

[1] The Bureau of Medicine and Surgery of the U. S. Navy does not necessarily undertake to endorse the views expressed in this paper.

Evidence that the Okinawan horses under study had been in contact with Japanese B virus was obtained also by neutralization tests. In this test, serum of Okinawan horse No. 1, which had a complement-fixing titer of 1: 128 against Japanese B virus, was combined with serum of Okinawan horse No. 3, which exhibited a titer of 1: 32 (horse serum Pool I, Table 1). Similarly, sera of Okinawan horses No. 2 and No. 19, each having a complement-fixing titer of 1: 32, were combined to form horse serum Pool II. Portions of each pool of Okinawan horse sera were mixed with equal volume of decimal dilutions of Nakayama strain of Japanese B virus, and the mixtures were incubated for 2 hours at room temperature. Serum of a normal Guamanian horse, and that of a rabbit which had received a number of inoculations of Japanese B virus were tested in the same manner. After incubation, the serum-virus mixtures were inoculated intracerebrally into mice, four animals being employed for each serum-virus dilution mixture. Mice surviving 18 days were regarded as protected. The protection afforded by each serum was estimated by the method of Reed and Muench (*3*).

An examination of Table 1 reveals that the titers of the virus in the presence of the sera comprising Pool I and Pool II were, respectively, $10^{3.5}$ and $10^{3.0}$. On the other hand, the titer of the virus mixed with serum of the normal Guamanian horse was $10^{8.0}$. The neutralization index, which is the ratio between the titer of the virus in the presence of the serum under test and its titer with normal serum, was, therefore, 30,000 for the sera of Pool I and 100,000 for Pool II. This means that these pools of sera possessed, respectively, 30,000 and 100,000 times more neutralizing power than that shown by normal horse serum. In fact, their protective action approached that of the serum of the hyperimmunized rabbit, which exhibited a protective index of 150,000. Experience has shown that a neutralization index greater than 1,000 is significant. The results recorded in Table 1 indicate that at least one of the two Okinawan horses furnishing serum for each pool had developed a high titer of neutralizing antibodies against Japanese B encephalitis virus.

The evidence thus furnished by both complement-fixation and neutralization tests supports the conclusion that the horses studied had had contact with Japanese B encephalitis virus. The nature of this contact is not known, but the results described support the idea that horses may have been of epidemio-

TABLE 1

NEUTRALIZATION TESTS WITH SERA OF OKINAWAN HORSES AND JAPANESE B VIRUS (NAKAYAMA STRAIN)

Serum	Titer of complement-fixing antibody	Sera used in neutralization test	Fate of mice following intracerebral inoculation of serum plus virus mixture								Titer of virus in presence of serum*	Neutralization index†
			Dilution of virus in mixture									
			10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}		
Okinawan Horse No. 1 Okinawan Horse No. 3	More than 1 : 128 1 : 32	Horse No. 1 and Horse No. 3 (Pool I)	4/4	4/4	0/4	0/4	0/4	0/4			$10^{3.5}$	30,000
Okinawan Horse No. 2 Okinawan Horse No. 19	1 : 32 1 : 32	Horse No. 2 and Horse No. 19 (Pool II)	4/4	2/4	0/4	0/4	0/4	0/3			$10^{3.0}$	100,000
Immune rabbit vaccinated against Jap B virus	Not tested	Immune rabbit	...	1/3	0/4	0/4	0/4	0/3			$10^{2.8}$	150,000
Normal Gaum Horse No. 4	0	Horse No. 4	...	4/4	4/4	4/4	4/4	4/4	2/4	0/4	$10^{8.0}$	1

* Titer of virus is expressed as the highest dilution of virus giving a 50-per cent mortality.

† Neutralization index is the ratio between the titer of the virus in the presence of the serum under test and its titer in the presence of serum of the normal horse.

4/4—Four of four mice injected died.

logic importance in the outbreak of Japanese B encephalitis which began on Okinawa during July 1945.

References

1. Casals, J., and Palacios, R. *J. exp. Med.*, 1941, 74, 409.
2. Hodes, H. L., Thomas, L., and Peck, J. L. *Proc. Soc. exp. Biol. Med.*, in press.
3. Reed, L. J., and Muench, H. *Amer. J. Hyg.*, 1936, 27, 493.

The Absorption of Orally Administered Penicillin[1]

Walsh McDermott, Paul A. Bunn, Maria Benoit,
Rebeckah DuBois, and Mildred E. Reynolds

Department of Medicine, Cornell University Medical College, and *The New York Hospital*
New York City

In a previous communication (*7*), it was reported that when penicillin was administered orally to fasting subjects the concentrations attained in the blood and the range of urinary excretion were of the same order of magnitude whether the penicillin was presumably protected against destruction in the stomach by the use of oil, oil-beeswax, or an antacid, or whether it was ingested as the aqueous solution. Regardless of vehicle, it was necessary to administer approximately five times as much penicillin by the oral as by the intramuscular route to obtain comparable concentrations of penicillin in the blood. In no instance was more than 32 per cent of the ingested penicillin excreted in the urine during the 12 hours immediately following ingestion.

This low urinary excretion after oral administration is in striking contrast to the 70 to 100 per cent urinary excretion which Martin and Kirby (*9*) have demonstrated after single parenteral doses. In experiments which will be published elsewhere (*8*), there was no evidence that penicillin is destroyed in the portal circulation. Moreover, penicillin is not destroyed by whole blood *in vitro* when incubated at 37° C. for a four-hour period. It appears, therefore, that the quantitative difference between the urinary excretion of penicillin after parenteral injection and that observed after oral administration represents the penicillin which is not absorbed. Presumably the material which is not absorbed after oral administration is either destroyed or excreted in the alimentary tract.

As it appeared that the destruction of penicillin by the acid of the stomach was not an entirely satisfactory explanation of the fate of the larger part of the ingested material, an investigation of the absorption, excretion, and destruction of penicillin following oral administration has been conducted, and a preliminary report on certain of the observations is presented at this time.

A study of the urinary excretion of penicillin after both oral and intramuscular administration was made in six subjects with complete achlorhydria. Five of the subjects had pernicious anemia. On successive days, each subject received identical doses of penicillin by the oral and by the intramuscular route. Nine such experiments were performed, seven after 300,000-unit doses and two after 25,000-unit doses. The penicillin determinations were made by the Rammelkamp method of bio-assay (*10*). All subjects were in a fasting state when the penicillin was ingested and during the succeeding four hours.

The results are presented in Table 1. As may be seen, the amount of penicillin excreted in the urine (per cent of the total dose) ranged from 36 to 100 per cent following intramuscular administration, and usually was more than 60 per cent.[2] Following oral administration, the range of urinary excretion varied between 8 and 32 per cent. In the comparative studies in each individual, the differences are striking. The amounts of penicillin appearing in the urine of these achlorhydric subjects after oral administration were within exactly the same range as had been observed previously in normal subjects (*7*) and were definitely less than appeared after intramuscular administration.

TABLE 1

Urinary Excretion of Penicillin Following Oral and Intramuscular Administration in Subjects With Complete Achlorhydria

Subject	Penicillin dosage	Urinary excretion in per cent of total dose		Period of observation
	Units	Oral	Intramuscular	Hours
1	300,000	15		8
	300,000		46	5
	300,000	32	64	8
	25,000	19	100	8
2	300,000	28		8
	300,000		97	10
	25,000		36	8
3	300,000	21	68	4
	25,000	14	64	8
4	300,000	26	55	8
	25,000		52	8
5	300,000	10	96	8
6	300,000	27	73	24
7	300,000	8		8

Data on the urinary excretion of ingested penicillin obtained from the published reports and from our own observations are presented in Table 2. As may be seen, the maximum urinary excretion (and hence absorption) of ingested penicillin which has been observed in the achlorhydric subjects and in normal subjects regardless of vehicle (*3, 4, 5, 7, 8, 12, 13*) is only 34 per cent. Although in one report (*6*) not included in the table, higher values were obtained, a repetition of the experiments (*5*) disclosed a maximum urinary excretion of only 33.8 per cent. A comparison of the extremes and the average values for the urinary excretion of penicillin ingested with and without acid neutralizing agents is of interest. With attempts at acid neutralization, the values for urinary excretion ranged from 3 to 33.6 per cent of the ingested dose, and the average values ranged from 6.7 to 20.2 per cent. Without attempts at acid neutralization, the values are from 1.9 to 32.5 per cent (extremes) and 6.3 to 20.1 per cent (averages). Thus, the range of urinary excretion of orally administered penicillin is of the same order of magnitude in subjects with achlorhydria as in normal subjects, regardless of whether attempts are made to neutralize the gastric acidity of the latter.

---

[1] The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Cornell University Medical College.

[2] The difference between the values for the urinary excretion of penicillin in these experiments and the 70 to 100 per cent excretion noted by Martin and Kirby is presumably because fewer dilutions of a given specimen of urine were assayed in the present experiments.

TABLE 2

URINARY EXCRETION OF ORALLY ADMINISTERED PENICILLIN

Report	Dose (units penicillin)	Period of observation (hours)	No. of subjects	Vehicle	Protective agents	Per cent of total dose recovered	
						Average	Range
McDermott, Bunn, *et al.*	100,000–300,000	12–24	9		Absent	18.4	3–32
"	100,000–300,000	12–24	6	Magnesium trisilicate and amphogel	Present	16.5	6–29
"	100,000–300,000	12–24	16	Oil suspension of penicillin, alone or with beeswax or shellac	Present	9.9	2–21
Charney, *et al.*	25,000	6–8	25		Absent	12.8	4.2–23.3
"	25,000	6–8	18	1.4–7.0 grams trisodium citrate	Present	13.9–15.6	6.6–32.5
Free, *et al.*	100,000	6	4		Absent	20.2	8.8–33.6
"	100,000	6	3	10.0 grams $NaHCO_3$	Present	6.3	1.9–12.7
Heatley	15,000	7–8	3		Absent		4.2–15.5
"	27,500	7–8	1		Absent		13.3
"	15,000	7–8	3	Egg and $NaHCO_3$	Present	20.1	11.0–33.8
"	27,000	7–8	1	"	Present		18.0
Welch	100,000	7	10		Absent	6.7	Not stated
"	100,000	24	11	Amphogel adsorption	Present	18.6	5.5–27.8
"	100,000 in 4 divided doses		11	"	Present	7.2	1.2–15.0
Rammelkamp and Keefer	10,000	3	1		Absent		10.1
"	20,000	3½ (210 min.)	1		Absent		3.2
"	20,000	1⅓ (85 min.)	1	40 grams $NaHCO_3$	Present		5.3

This suggests that the lower concentrations of penicillin which are attained in the blood and urine after oral, as compared with parenteral, administration are chiefly the result of a defect in absorption and not primarily due to penicillin lost by acid destruction. Presumably the penicillin which is not absorbed would be destroyed in the gastrointestinal tract or excreted in the stool.

In several experiments a variable amount of an antibacterial substance, presumably penicillin, was extracted from the stools of subjects who had ingested single large doses of penicillin, but was not present in the stools of the same subjects after the intramuscular administration of penicillin. Since the amount of penicillin present in the stools represented only a small fraction of the ingested dose, it appeared probable that the majority of the material was destroyed in the intestinal tract.

Both in the cat and in man almost all of penicillin absorption occurs from the small intestine, and only minute amounts can be absorbed from the colon (*8*). Rammelkamp and Helm (*11*) have demonstrated that the incubation *in vitro* of penicillin with succus entericus (and with bile) caused no loss of activity. Therefore, it appeared probable that the destruction of a large part of the material which was neither absorbed nor excreted occurred distal to the duodenum, in the lower ileum or colon.

In the original report on the pharmacology of penicillin by Abraham, *et al.* (*2*), it was mentioned that feces inactivate penicillin, but no details were presented. Subsequently it was established (*1*) that a penicillinase could be extracted from *E. coli*. Since no information was available on the rate of the inactivation of penicillin by feces, known amounts of penicillin were incubated *in vitro* at 37° C. with emulsions of stool specimens from presumably normal individuals. The technique used for the assay of penicillin in feces is described elsewhere (*8*).

The results of five representative experiments are presented in Fig. 1. As may be seen, 80 to 100 per cent of the penicillin was inactivated by incubation with emulsion of stool for 24 hours. No inactivation was demonstrable in one experiment which was conducted for only four hours. In general, the rate of inactivation varied, but considerable destruction had usually occurred by the end of the third hour of incubation. When emulsions of stool were passed through a Seitz filter prior to incubation with penicillin, little or no destruction of the penicillin occurred, although unfiltered specimens from the same emulsion destroyed penicillin.

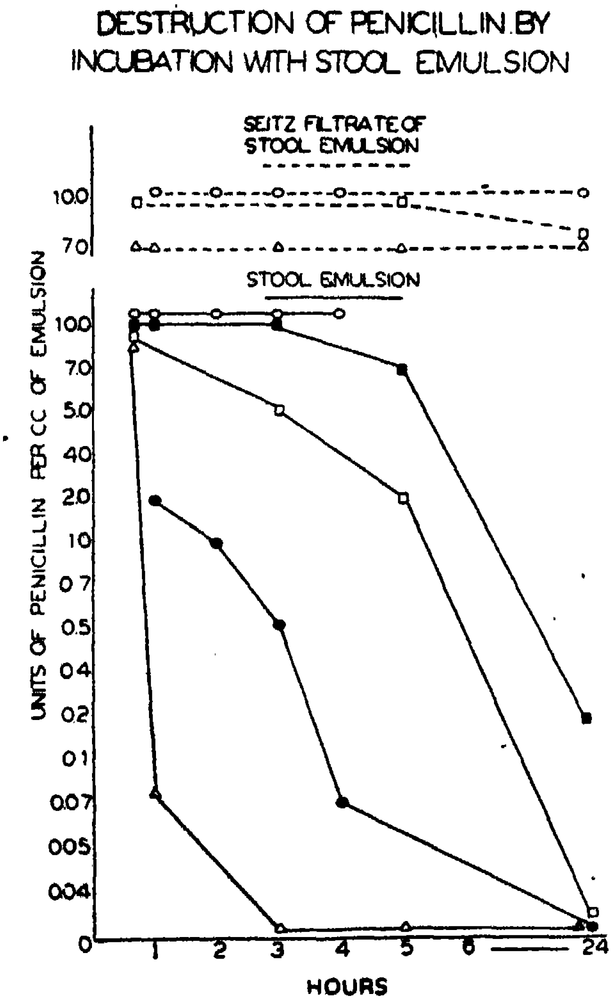


FIG. 1

Thus, there are two mechanisms for the destruction of penicillin in the alimentary tract: the secretion of acid in the stomach and some agent, presumably bacterial, in the intestine. It is impossible to determine in an individual case the relative proportions of an ingested dose of penicillin which are destroyed by these respective mechanisms. One operates before, the other after, the penicillin has reached the site of greatest absorption, the duodenum (8). Of greater importance, however, is the fact that even if destruction by acid does not occur at all, because of achlorhydria, successful neutralization, or the normal fluctuations of gastric acidity, the greatest absorption which has been noted is only 34 per cent of the ingested dose. The penicillin which is not absorbed is eventually destroyed by the action of the second mechanism or is excreted in the feces.

It appears, therefore, that the maximal benefit which is attainable from protecting the penicillin against acid destruction is limited to the difference between the amount of absorption which occurs in the absence of such protection and the maximal absorption which has been noted when acid destruction is not a factor. As the theoretical advantage of protection of all of the material against acid is so largely counterbalanced by the fact that no more than a third of the ingested dose is absorbed in any event, it would seem that no penicillin preparation for oral use which is based solely on the principle of protection against acid will prove to be significantly superior to penicillin alone.

Furthermore, in the presence of maximum absorption approximately three times as much penicillin is required by the oral as by the intramuscular route to produce comparable penicillin concentrations in the blood. Since maximum absorption does not generally occur, the usual ratio of oral to intramuscular dosage will be in the neighborhood of 5:1.

References

1. Abraham, E. P., and Chain, E. *Nature, Lond.*, 1940, **146**, 837.
2. Abraham, E. P., Chain, E., Fletcher, C. M., Gardner, A. D., Heatley, N. G., Jennings, M. A., and Florey, H. W. *Lancet*, 1941, **2**, 177.
3. Charney, J., Alburn, H. E., and Bernhart, F. W. *Science*, 1945, **101**, 251.
4. Free, A. H., Leonards, J. R., McCullagh, D. R., and Biro, B. E. *Science*, 1944, **100**, 431.
5. Heatley, N. G. *Lancet*, 1945, **1**, 590.
6. Little, C. J. H., and Lumb, G. *Lancet*, 1945, **1**, 203.
7. McDermott, W., Bunn, P. A., Benoit, M., DuBois, R., and Haynes, W. *Science*, 1945, **101**, 228.
8. McDermott, W., Bunn, P. A., Benoit, M., DuBois, R., and Reynolds, M. E. *J. clin. Invest.*, in press.
9. Martin, S. P., and Kirby, W. M. M. (To be published.)
10. Rammelkamp, C. H. *Proc. Soc. exp. Biol. Med.*, 1942, **51**, 95.
11. Rammelkamp, C. H., and Helm, J. D., Jr. *Proc. Soc. exp. Biol. Med.*, 1943, **54**, 324.
12. Rammelkamp, C. H., and Keefer, C. S. *J. clin. Invest.*, 1943, **22**, 425.
13. Welch, H., Price, C. W., and Chandler, V. L. *J. Amer. med. Ass.*, 1945, **128**, 845.

Effect of Penicillin on Growth of *Alcaligenes fecalis*

MacDonald Fulton, Charles E. Lankford, and
Martha Chilton
University of Texas School of Medicine, Galveston

The literature contained no information on the effect of penicillin on *Alcaligenes fecalis* previous to a recent paper by Altemeier (*1*), who reported the marked susceptibility of five strains to penicillin. In view of the well-known fact that gram-negative bacilli are in general relatively resistant to this antibiotic, it seemed advisable to test a larger number of strains of this species.

Nine strains of *Alcaligenes* were available in stock, six having been collected from human feces and three from human urine. The tests were carried out on Bacto Proteose No. 3 hemoglobin agar plates containing various concentrations of penicillin, as used routinely for tests of penicillin resistance in our laboratory. The plates were inoculated from young tryptose phosphate broth cultures by making a radial streak with the tip of an absorbent cotton swab dipped in the broth culture. They were examined after overnight incubation at 37.5° C.

In repeated tests no inhibition was observed at penicillin concentrations less than 10 units/ml. of agar. In a typical experiment, only one of the nine strains was inhibited by 10 units/ml. Fifty units inhibited another strain and almost completely inhibited a third. At 100 units, five of nine strains were still able to grow, although somewhat inhibited as compared with controls.

We have thus been unable to confirm the findings of Altemeier. Despite the fact that the genus *Alcaligenes* is now separated from the *Enterobacteriaceae* and grouped with other genera in the family *Rhizobiaceae,* it occurs with, and resembles physiologically, the members of the former family. The resemblances include insensitivity to penicillin.

Reference

1. ALTEMEIER, W. A. *Surg. Gynec. Obstet.*, 1945, 81, 379.

Intravenous Utilization of Partial Acid Hydrolysates of Proteins

WILLIAM C. RISSER, JAY R. SCHENCK, and DOUGLAS V. FROST[1]
Abbott Laboratories, North Chicago, Illinois

Complete hydrolysates of casein fortified with tryptophane and cysteine monohydrochloride monohydrate were given intravenously to female dogs. The hydrolysates were given daily in one injection over a period of 80 minutes in some experiments and two hours in others. The minimum intake of nitrogen which maintained nitrogen balance was approximately 120 mg./N/kg./day. By the method of White and Elman (*1*) we have prepared partial acid hydrolysates in which approximately one-third of the amino acids exist in the free state. When these hydrolysates were fortified to the same content of tryptophane and cysteine as employed in the complete hydrolysates, nitrogen balance was produced at an intake of 120 mg./N/kg./day. Thus, the peptide nitrogen of a partial acid hydrolysate appears to be available for the purpose of maintaining nitrogen balance in the adult dog when the hydrolysate is given intravenously.

TABLE 1

SUMMARY OF NITROGEN BALANCE EXPERIMENTS

Hydrolysate	Total N* / Wt. of tryptophane present†	Total N* / Wt. of cysteine HCl · H₂O added	Dog No.	Injection time (minutes)	Intake of hydrolysate in mg./N/kg./day	Balance in grams/N/week
Casein, complete	12.0 (dl-tryptophane added)	4.90	1	80	100	− 0.94
					80	− 0.99
					120	− 0.49
Casein, complete	12.0 (dl-tryptophane added)	3.31	2	80	100	− 1.33
					80	− 0.99
					120	+ 0.26
Casein, partial	11.0 (l-tryptophane added)	4.83	1	80	120	+ 0.33
					100	− 0.38
					80	− 0.62
			2		120	− 0.14
					140	+ 0.54
Casein, partial	25.0 (no tryptophane added)	4.88	3	80	140	+ 0.78
				"	140	+ 0.20‡
				100	120	+ 0.14
				90	100	− 0.05
Fibrin, partial	9.0 (no tryptophane added)	14.06	4	120	100	+ 1.02
					100	− 0.13‡

* In this ratio, Total N represents nitrogen (in grams) of the hydrolysate before any additions of amino acids were made.

† The amount of tryptophane in the partial hydrolysates was determined. "Tryptophane present" represents the amount (in grams) of the tryptophane retained in the partial hydrolysate plus the quantity added; for the complete hydrolysates, it represents the amount added.

‡ Five-day periods.

The nonprotein diet consisted of 73 grams sucrose, 20 grams lard, 3 grams corn oil, 0.5 gram fish-liver oil containing 65,000 U.S.P. units of vitamin A and 13,000 U.S.P. units of vitamin D per gram, 4.0 grams U.S.P. salt mixture I, 0.2 gram choline chloride, 1.0 gram agar, 0.6 mg. thiamine hydrochloride, 0.6 mg. riboflavin, 12.0 mg. nicotinamide, 0.4 mg. pyridoxine, 1.2 mg. calcium pantothenate, and a liver concentrate low in nitrogen but rich in vitamin B_c. The amount of this diet consumed usually supplied considerably less than 5 per cent of the total nitrogen intake.

Reference

1. WHITE, A., and ELMAN, ROBERT. *J. biol. Chem.*, 1942, 143, 797.

---

[1] With the collaboration of Robert T. Olsen, Oscar H. Walther, and Everett W. Doede.

The authors wish to thank Dr. E. H. Volwiler, Mr. Carl Nielsen, and Dr. D. W. MacCorquodale for encouragement and counsel in the course of this work, and to acknowledge the cooperation of Mr. H. C. Spruth in various phases of the problem.

The Presence in Normal Serum of Inhibiting Substances Against *Bacillus subtilis*[1]

C. W. Buggs, Bernice Bronstein, John Winslow Hirshfeld, and Matthew A. Pilling

Departments of Bacteriology and Surgery, Wayne University College of Medicine, and Receiving Hospital, Detroit, Michigan

In initiating an investigation of the absorption and excretion of streptomycin in humans, it was necessary to find an organism whose sensitivity to the antibiotic was such that it could be used as a test organism in determining the concentration of streptomycin in body fluids. *Bacillus subtilis*, No. 4R6259, received from the Merck Institute, appeared to have the required sensitivity and was selected for use in the study.

TABLE 1

Titration of Inhibiting Substances in Normal Serum for *Staphylococcus aureus*, No. 209 P, and for *Bacillus subtilis*, No. 4R6259

Serum No.	Unheated serum Dilution at which organism is inhibited *Staph. aureus* No. 209 P	 *B. subtilis* No. 4R6259	Serum heated 30 min. at 56° C. Dilution at which organism is inhibited *Staph. aureus* No. 209 P	 *B. subtilis* No. 4R6259
1	No inhibition	No inhibition	No inhibition	No inhibition
2	No inhibition	1 : 2	No inhibition	Undiluted
3	No inhibition	1 : 8	No inhibition	1 : 2
4	No inhibition	No inhibition	No inhibition	No inhibition
5	No inhibition	1 : 32	No inhibition	1 : 32
6	No inhibition	1 : 8	No inhibition	1 : 4
7	No inhibition	1 : 8	No inhibition	No inhibition
8	No inhibition	1 : 4	No inhibition	No inhibition
9	No inhibition	No inhibition	No inhibition	No inhibition
10	No inhibition	1 : 8	No inhibition	1 : 4
11	No inhibition	1 : 4	No inhibition	1 : 2
12	No inhibition	1 : 4	No inhibition	1 : 2
13	No inhibition	Undiluted	No inhibition	No inhibition
14	No inhibition	1 : 4	No inhibition	1 : 2
15	No inhibition	1 : 4	No inhibition	1 : 2
16	No inhibition	1 : 8	No inhibition	No inhibition
17	No inhibition	1 : 8	No inhibition	1 : 2
18	No inhibition	1 : 8	No inhibition	No inhibition
19	No inhibition	No inhibition	No inhibition	No inhibition
20	No inhibition	1 : 2	No inhibition	No inhibition
21	Not tested	1 : 8	Not tested	No inhibition
22	No inhibition	1 : 2	No inhibition	No inhibition
23	No inhibition	1 : 4	No inhibition	No inhibition
24	No inhibition	1 : 8	No inhibition	1 : 4
25	No inhibition	1 : 8	No inhibition	1 : 2
26	No inhibition	1 : 8	No inhibition	1 : 2
27	No inhibition	1 : 4	No inhibition	1 : 2
28	No inhibition	No inhibition	No inhibition	No inhibition
29	No inhibition	1 : 2	No inhibition	1 : 2
30	No inhibition	1 : 2	No inhibition	No inhibition
31	No inhibition	1 : 4	No inhibition	1 : 2
32	Not tested	1 : 2	Not tested	Not tested
33	No inhibition	1 : 2	No inhibition	1 : 2
34	No inhibition	1 : 4	No inhibition	1 : 2
35	No inhibition	1 : 4	No inhibition	1 : 4

Before administering the streptomycin to patients chosen for the study a sample of blood was drawn from each as a control. In the first series of tests it was found that the serum inhibited the growth of *Bacillus subtilis* in dilutions varying up to 1:32.

Because of these findings, a titration of serum from 35 normal individuals was made in order to determine to what extent these inhibiting substances occurred. The sera were also tested to learn if inhibiting antibodies were present for a strain of *Staphylococcus aureus* (No. 209 P of the Food and Drug Administration). Unheated serum and serum inactivated at 56° C. for 30 minutes were used. Table 1 summarizes the results.

Thirty out of 35 of the sera inhibited the growth of *Bacillus subtilis*, while 5 of them failed to inhibit this organism. After inactivating the serum at 56° C. for 30 minutes, 10 of the sera lost their ability to inhibit, 15 partially lost their ability by a reduction in titer, and 4 were uninfluenced. (One sample, No. 32, was not tested in the inactivated state.)

Two additional strains of *Bacillus subtilis* were tested in 5 of the sera listed in Table 1. Both of them were inhibited by each of these sera. The 5 sera which failed to inhibit strain No. 4R6259 were not tested for inhibiting substances against these 2 additional strains.

Thirty-three of the sera were tested against *Staphylococcus aureus*, No. 209 P. None of them possessed inhibiting substances against this organism. Some of the sera were tested against several other strains of staphylococci, but in no instance were inhibiting substances demonstrated.

---

[1] The work described in this paper was supported by grants from the Theodore A. McGraw Fund and from Merck and Company, Rahway, New Jersey.

Randall, Price, and Welch (*2*) have suggested the use of *Bacillus subtilis* as a test organism in assaying penicillin in various body fluids by a modification of the dilution method of Rammelkamp (*1*). This organism was proposed because of the ease with which it may be cultivated, the sharp reproducible end-points said to be obtained, and because its use obviates the employment of washed erythrocytes as required in the Rammelkamp technic. These investigators did not state, however, whether or not serum obtained from patients before the administration of penicillin inhibited their test organism.

The data presented in this paper would indicate that the results of any assay of serum for an antibiotic, using *Bacillus subtilis* as the test organism, are open to question, unless, prior to the administration of the antibiotic, the serum has been tested for the presence of natural inhibiting antibodies.

Summary: Sera from 35 normal persons who had received no previous medication were tested for inhibiting substances against *Bacillus subtilis* and *Staphylococcus aureus*. Thirty of the sera (85 per cent) inhibited *Bacillus subtilis* in dilutions varying up to 1:32, but in no instance was *Staphylococcus aureus* inhibited. The data presented would indicate that *Bacillus subtilis* is not a suitable organism for use in the assay of antibiotics in the presence of serum.

References

1. Rammelkamp, C. H. *Proc. Soc. exp. Biol. Med.*, 1942, **51**, 95–97.
2. Randall, W. A., Price, C. W., and Welch, H. *Science*, 1945, **101**, 365–366.

Preliminary Studies on the Absorption and Excretion of Streptomycin in Dogs

Boyd E. Graham, Milton J. Vander Brook, and
Marvin H. Kuizenga
*Research Laboratories, The Upjohn Company
Kalamazoo, Michigan*

Pharmacologic studies on three lots of streptomycin, ranging in potency from 105 to 500 units/mg., were done on 14 male and female dogs. The animals were starved or fed a liquid diet for 24 to 48 hours prior to administration of streptomycin. They were divided into four groups. Only the dogs in Group 1 were anesthetized, and these experiments were acute. Intravenous (saphenous vein) administration was employed in Groups 1 and 2. The intramuscular (gluteal) route was used in Group 3 and oral administration (stomach tube) in Group 4. Urine samples were collected by catheterization from all dogs of Group 1, from one dog of Group 3, and from two dogs of Group 4. All other urines were collected via the metabolism cage.

Plasma volumes and streptomycin levels were calculated from haematocrit determinations. By our method of assay (*3*), using a paper disc-agar plate, neither plasma nor urine in a twofold dilution with a 0.2-M phosphate buffer exerts an inhibitory effect on the test organism (*Bacillus subtilis*).

Results

In general, the rates of disappearance of streptomycin from the blood of anesthetized and unanesthetized dogs (Groups 1 and 2) following intravenous injections of 100,000 to 210,000 units were comparable. Only 18 to 29 per cent could be accounted for in the plasma during the period of 3 to 18 minutes postinjection. After 4 to 5 hours about 3 per cent could be detected in the plasma. The low total recovery of streptomycin (16 to 20 per cent of the amount injected) from the urines of the dogs in Group 1 may be due to the short experiment, or to anesthesia, since 45 to 65 per cent was recovered from the urines of Group 2. Approximately 35 to 55 per cent of the streptomycin injected was probably destroyed or inactivated. These results are in agreement with those found in humans (*1, 2, 4*). The purity of the three lots of streptomycin used apparently did not alter the results.

In Group 3, the highest plasma levels were 7.2 and 2.7 per cent of the injected amounts (100,000 units). These were reached after 1 and 1½ hours, respectively. After 5½ hours only a trace to 0.8 of one per cent could be detected. Therefore, the maintenance of plasma levels was no better with intramuscular than with intravenous injection. Only about 20 to 40 per cent of the stretopmycin administered could be recovered in the urines of this group.

In Group 4, streptomycin in doses from 210,000 to 420,000 units per dog could not be detected in the blood during the 24 hours following oral administration. The recovery in the urine of one dog of this group of 3.9 per cent of the drug administered, and lesser amounts in the others, indicates that streptomycin was absorbed to a small extent. The small percentage recovered in the urine is in agreement with the observations made on humans (*1, 2, 4*).

Summary

Streptomycin varying in potency from 100 to 500 units/mg. has been administered to 14 dogs intravenously, intramuscularly, and orally in amounts of 100,000 to 420,000 units.

High blood levels of streptomycin were observed after parenteral administration and 23 to 65 per cent was excreted in the urine of normal dogs. After 4 or 5 hours only small amounts were detected in the blood.

The maintenance of blood levels was no better with intramuscular than with intravenous administration.

Following the oral administration of as much as 420,000 units of streptomycin, it could not be detected in the plasma, but up to 3.9 per cent was recovered from the urine.

References

1. Elias, Wm. F., and Dursa, Jane. *Science*, 1945, **101**, 589.
2. Heilman, D. H., Heilman, F. R., Hinshaw, H. C., Nichols, D. R., and Herrell, W. E. *Amer. J. med. Sci.*, in press.
3. Loo, Y. H., *et al.* *J. Bact.*, in press.
4. Reimann, H. A., Elias, Wm. F., and Price, A. H. *J. Amer. med. Ass.*, 1945, **128**, 175.

The Activity of Streptomycin in Experimental Syphilis

Wolcott B. Dunham and Geoffrey Rake

The Squibb Institute for Medical Research
New Brunswick, New Jersey

The striking therapeutic response following the treatment of syphilis with penicillin prompted the investigation of the action of streptomycin in experimental syphilis.[1]

Herrell and Nichols (*1*) have recently reported the results of the treatment of four cases of syphilis with streptomycin. Improvement was noted, but relapses occurred even after the administration of 10,000,000 units over a period of 10 days.

The technique employed in the present study will be described subsequently in full (*2*). A brief summary follows. Suspensions of rabbit testes infected with the Nichols strain of *T. pallidum* were employed to infect rabbits by intracutaneous injections in the clipped skin of the back. Commencing within three days, intramuscular injections of streptomycin or crystalline penicillin G[2] were made every four hours for four days. When lesions developed at the site of inoculation, their syphilitic nature was confirmed by dark-field examination for spirochetes. All other rabbits were kept for four months, at which time a suspension of the popliteal lymph nodes of each rabbit was injected intratesticularly in two rabbits. If the testes of these rabbits remained normal, the donor rabbit was judged to have been cured. The streptomycin preparations employed had potencies of 158 units/mg. to 229 units/mg.

A total of 79,000 units of streptomycin per kilogram of body weight protected one out of three rabbits. The three rabbits that received 650,000 units/kg. were also proved to have been cured. In another experiment, the lymph node transfers have not yet been made from the rabbits that have remained free of local lesions, but in the case of other rabbits that have been infected by the technique described above, lymph node transfers have not changed significantly the results obtained by reading the dermal lesions. In this experiment, none of the four rabbits in each of the groups that received 748,000 units/kg. and 374,000 units/kg. developed lesions. Of the four rabbits that received a total of 187,000 units/kg., three failed to develop chancres. A total of 93,500 units/kg. did not protect any of the four rabbits in this group. All control rabbits in each experiment developed typical lesions.

The smallest amounts of streptomycin that cured any of the rabbits when administered in divided doses during four days was 79,000 units/kg. (375 mg./kg.) in one experiment and 187,000 units/kg. (817 mg./kg.) in another. A similar effect was obtained with 147 units/kg. (0.088 mg./kg.) of crystalline penicillin G. It may be concluded, therefore, that the preparations of streptomycin employed have antisyphilitic action but that penicillin G is more than 3,000 times as effective.

References

1. Herrell, W. E., and Nichols, D. R. *Proc. Staff Meet., Mayo Clin.*, 1945, **20**, 449.
2. Rake, Geoffrey, and Dunham, W. B. (To be published.)

---

[1] The authors wish to express their appreciation to John J. Oskay for his technical assistance.

[2] *Obtained through the courtesy of Dr. O. P. Wintersteiner and Dr. Max Adler, Division of Organic Chemistry, The Squibb Institute for Medical Research.*

Scanning Science—

National University

The bill establishing a National University of the United States has been reported favorably by the Senate committee. It grants a charter to the University, provides for its government, grants it the ground in the city of Washington designated by President Washington as a site for a national university, and appropriates $15,000 for the fiscal year ending on June 30, 1897, and $25,000 for the year following.

Princeton University

At the recent meeting of the Board of Trustees of the College of New Jersey at Princeton it was voted to change the charter name of the institution to Princeton University. The fund which is being raised in commemoration of the Sesquicentennial next October is already over $900,000, a large proportion of which, it is said, will be devoted to the development of the graduate department.

—20 March 1896

News and Notes

Dr. John W. T. Spinks, professor of physical chemistry at the University of Saskatchewan, has rejoined the staff after two and a half years of operational research with the Royal Canadian Air Force and nuclear research at the laboratories of the National Research Council of Canada.

Dr. H. R. Gault, formerly of the U. S. Geological Survey, has been appointed an assistant professor of geology at Lehigh University.

Announcements

The Geological Society of Washington, comprising the professional geologists in the Washington area, adopted the following resolution at a meeting on 13 March, 1946:

> We, the 400 members of the Geological Society of Washington, D. C., unanimously endorse the McMahon Bill, S. 1717, in its original form. We believe that no bill will provide a satisfactory domestic policy on atomic energy that does not provide for: 1. Full control over atomic energy development in this country by the Federal Government; 2. Complete civilian control through a Federal agency—the role of the military to be restricted to liaison in the field of weapons; 3. A policy of free publication and dissemination of scientific information, restricted only by the provisions of the Espionage Act.
>
> We further believe that a bill lacking any of these features will stifle scientific progress and will, consequently, irreparably harm our civilization and greatly weaken the national defense.

The resolution was addressed to the President and the Congress. It marks a departure in the policy of the Society which has never heretofore concerned itself with legislative matters.

An annual award of $1,000 and a bronze medal for outstanding research in enzyme chemistry has been added to the list of awards administered by the American Chemical Society, according to Alden H. Emery, national secretary of the Society. The new award is sponsored by the Paul-Lewis Laboratories, Inc., of Milwaukee, Wisconsin, and will be known as the Paul-Lewis Laboratories Award in Enzyme Chemistry. The first award will be presented by the Society in April to one of a group of candidates now under consideration by a special committee.

McGill University has announced a recently created Department of Anaesthesia. The chief objectives are to improve the teaching of anaesthesia to the undergraduate students in Medicine; to increase the opportunities for learning anaesthesia among the释 internes of the hospitals connected with the University; to conduct a three-year Diploma Course in Anaesthesia; and to develop investigation in anaesthesia in the clinic and in the laboratory from the point of view of interrelationship, and in an interdependent fashion with the University's other departments. This development comes on the centenary of the discovery of anaesthesia.

Dr. F. A. Vening Meinesz, professor of geophysics at the University of Utrecht, director of the Royal Netherland Meteorological Institute, and recent recipient of the Penrose Medal of the GSA, gave a series of four lectures at the invitation of the University of Cincinnati Chapter of Sigma Xi and the Departments of Geology and Physics. The subjects discussed were: "Gravity Anomalies in the East and West Indies," "Tectonic Patterns of the Ocean Floor and Their Interpretation," and "Newer Conceptions of Isostasy and Crustal Structure in the Light of Gravity Determinations." The illustrated public lecture on "Weighing the Earth From a Submarine" was followed by informal talks to faculty and student groups on "The Resistance Movement in Holland During the Occupation" and "The Danger of a Spiritual Vacuum in a Scientific Age."

Additional AAAS Meeting Notes

Headquarters for the Press will be in the Kiel Memorial Auditorium. Dr. Sidney S. Negus, Medical College of Virginia, Richmond, will be in charge.

The National Association of Science Writers will meet in Private Dining Room No. 7 of the Jefferson Hotel at 7:45 P.M., 27 March.

The St. Louis housing situation is still desperate. The most recent development is that a request from Dr. F. R. Moulton in the name of the Association to the Secretary of War for 1,500 berths in the Jefferson Barracks, Missouri, has been denied.

Recent Deaths

Ulphian Carr Loftin, 55, for the past 15 years assistant head of the Division of Cotton Insect Investigations in the U. S. Department of Agriculture's Bureau of Entomology and Plant Quarantine, died on 16 January in Washington, D. C.

Dr. Charles Theodore Burnett, 72, professor of psychology at Bowdoin College, died at Brunswick, Maine, on 31 January. He had retired in 1944, but had continued to teach to augment a war-depleted faculty.

Science Exhibition

(Continued from 1 March issue.)

Ace Glass, Incorporated

Vineland, New Jersey

Booth No. 125

In our effort continually to widen the scope and application of our spherical joints, we are now exhibiting and supplying these joints in new sizes and in different materials other than pyrex glass. The new sizes, namely, 40/25, 75/50, 102/75, and 130/90, will make it possible to have spherical connections on glass pipe and large-size glass tubes and still have the same flexible, nonfreezing, and interchangeable features of our standard line. The standard line of joints will be available in stainless steel and clear fused quartz. The new sizes listed above will be available in metal only. These joints will all be interchangeable so that installations having metal lines can be clamped together with the glass just as readily as the regular glass joint. In order to facilitate clamping of these joints we are going to feature our new-type clamp, which will be radically different from any offered on the market today. One of the features of our exhibit will be a large pilot plant-size evaporator, constructed entirely of pyrex glass from the stopcock manifold to the heat exchanger tubes. It will be possible to operate it continuously or for batch operations, both at atmospheric or lower pressures. In addition, there will be many smaller items, such as the split flask, or resin flask, from 500 ml. to 5,000 ml.; the light oil pycnometer, now tentative ASTM No. E845; various distilling columns, such as the Penn State Semi Micro Column, which has a column length of but 11″ and a separating power of 50 plates.

Bausch & Lomb Optical Company

Rochester, New York

Booth No. 134

This exhibit includes a stereoscopic polarizing device of new design, laboratory microscopes, wide field stereoscopic microscopes, micro-projectors, and Balopticons. The new B & L Stereo Polarizer produces stereoscopic vision through monobjective laboratory microscopes with binocular eyepieces. This is accomplished by a split-field polarizer, showing halves of the field polarized at right angles to each other, and two eyepiece analyzers, each of which can be aligned with one-half of the polarizer field. The B & L CTA Microscope has inclined binocular eyepieces, Abbe condenser, mechanical stage, and other accessories for advanced microscopy. A simpler model, the Bausch & Lomb BA Microscope has a monocular body but is otherwise similar to the CTA. Models A and FB are simpler microscopes designed primarily for educational use. The B & L BKW Stereoscopic Wide Field Microscope shows objects right side up in three dimensions. Fitted with a revolving drum nosepiece, it affords instantaneous change of magnification. The B & L B Micro-Projector utilizes any standard laboratory microscope. Since the stage is always horizontal, this projector is well adapted to showing living or wet mount specimens. Combining opaque and slide projection, the LRM Balopticon projects quiz papers, book pages, slides, solid objects and other material.

Biological Abstracts

University of Pennsylvania

Booth No. 130

A cooperative, nonprofit journal published by biologists for biologists. *Biological Abstracts* is the only abstracting and indexing service in the world that affords an adequate coverage of the literature in all fields of biology. Currently abstracting some 2,300 journals, the coverage is being expanded as rapidly as possible to include the many European and Scandinavian journals that have not been available to the scientists of this country since the outbreak of the war. *Biological Abstracts* is published not only in the complete edition but also in eight low-priced sectional editions specially designed for individual biologists who are interested only in one or more closely related fields. These sectional editions will be on display, and Dr. John E. Flynn, editor-in-chief, and H. I. Anderson, business manager, will be in attendance to welcome visitors and furnish information.

Distillation Products, Inc.

Rochester, New York

Booth No. 152

Users of high-vacuum equipment looking for the latest and best in vacuum producing, measuring, and controlling units will find a complete display of fractionating diffusion pumps, vacuum gauges, and high-vacuum valves at the Distillation Products exhibit. Featured here, in operation, will be vertical metal fractionating diffusion pumps—ranging in capacity from 2 1/sec. to 260 1/sec.—which mark an entirely new and highly efficient principle in the production of low pressures. Recent developments in high-vacuum valves—which provide greater control with lower impedance—are to be represented by especially designed valves in the 2″ and 4″ sizes plus a solenoid valve for ¼″ lines. The latest models of D.P.I.'s newest gauges, which include those of the Knudsen, Philips, Pirani, and Ionization-type, will also be on display. This group of gauges provides a series capable of accurately reading pressures from .00000001 mm. to 1 mm. of mercury. Design changes which make the new gauges of particular interest to industrial and laboratory users include the following: The Knudsen gauge has been improved so that satisfactory operation can be obtained under normal factory conditions of vibration; the Philips gauge has been constructed to give readings from 25 microns to 2×10^{-5} mm., and yet is so built that it will not be damaged by accidental exposure to atmospheric pressure; the Pirani gauge has been stabilized with respect to voltage and made into a continuously recording gauge for the range of 0 to 1000 microns; the familiar type of hot filament ionization gauge has been equipped with a new type of flexible control for use between 1 micron and below 10^{-6} mm. Hg. In addition to the equipment described above, examples of other gauges and D.P.I.'s two- and three-stage glass fractionating pumps for obtaining extremely low pressures without cold traps will be shown. Information and illustrative material will also be available on larger diffusion and ejector-type vacuum pumps, high-vacuum evaporating equipment, and stills for high-vacuum distillation.

J. H. Emerson Company

Cambridge, Massachusetts
Booth No. 111

In this booth will be shown the Emerson micromanipulator, which operates on a lever principle so that the motion of the lever which controls horizontal motions of the needle is identical with the apparent motion of the operating needle in the field of a compound microscope. This feature makes possible much more rapid control of the needle and makes it easier for an operator to learn to use the machine. There will also be shown the Emerson model of the Barcroft-Warburg apparatus. The J. H. Emerson Company was first to manufacture this apparatus continuously ever since. Literature will be available on the medical line of equipment manufactured by the company including "iron lungs, resuscitators, oxygen humidification apparatus, hot pack apparatus, fever therapy apparatus, and a new device for treatment of tuberculosis by means of lung immobilization."

E. Leitz, Inc.

New York, New York
Booth No. 148

This exhibit will include the following instruments: the *Leitz Photo-electric Precalibrated Colorimeter*, an instrument used for colorimetric determinations of human body fluids; the *Leitz Photo-electric Hemoglobinometer*, a portable instrument designed for use by individual practitioners so that they can make rapid colorimetric determinations of the hemoglobin content of the blood stream; the *Leitz G & D Electric Titrator*, an instrument used to determine by electronic means the end-point of a chemical titration; the *Leitz Magarc*, a completely automatic carbon arc microscope lamp giving a highly intense source of illumination; the *Leitz Microlux*, a Universal Microscope lamp used for visual observation, photomicrography, and microprojection; the *Leitz Micam*, a camera attachment which will fit any microscope accommodating standard eyepieces, produces a 3¼ × 4¼ negative, and may be used for making black-and-white or Kodachrome photomicrographs; the *Leitz Micro-Manipulator*, an instrument permitting manipulation of specimens during microscope observations; *Leica* camera accessories —American made lenses, view finders, and other devices for use in scientific photography.

Mallinckrodt Chemical Works

St. Louis, Missouri
Booth No. 55–56

"Research and Development for Today and Tomorrow" will be featured with an exhibit of a variety of new organic products as a consequence of fundamental researches by Mallinckrodt chemists on ester condensations. Among samples available for inspection will be oxazolidones, malonic esters, and higher alkyl carbonates such as dicetyl carbonate and dioctadecyl carbonate. Phenylacetic acid and phenylacetic ester also will be exhibited. In addition to the above compounds, the exhibit will include pyridylmercuric acetate, pyridylmercuric chloride, and pyridylmercuric stearate, which are effective fungicides and mildew-proofing agents. These compounds may be incorporated in textiles, felt, leather, cork, paints, wood, rubber, resins, and waxes. Mallinckrodt Chemical Works is cited in the Smyth report on atomic energy for having achieved in production "a degree of purity seldom achieved even on a laboratory scale." This achievement was in part possible because of many years of fundamental research and long experience in the production of analytical reagent, medicinal, photographic, and high-purity industrial chemicals. Examples such as Mallinckrodt Analytical Reagents and Primary Standards, universally known for uniform, dependable purity, will be exhibited. The high purity of these reagents is of specific interest to, and meets the exacting requirements of, research and clinical laboratories.

Merck & Company, Inc.

Rahway, New Jersey
Booth No. 123–124

The enormous success of penicillin in helping in the treatment of war injuries and diseases has made the chemotherapeutic importance of the newly investigated antibiotics of great scientific and public interest. The House of Merck has been in the forefront of antibiotic research in the United States from the early collaboration in the large-scale investigation of gramicidin in 1939 through the wartime development of penicillin, to its more recent interest in the newest antibiotic, streptomycin, discovered by Waksman in 1944. This exhibit, devoted entirely to the Story of Streptomycin, will show briefly the commercial history of the better-known antibiotics and trace the processing of an antibiotic from the parent organism to the pure crystalline compound. A brief resumé of the presently known chemistry will be outlined, and following an account of its pharmacological properties, the proposed clinical uses of this chemotherapeutic agent are briefly listed. By means of illuminated transparencies below the background panels of the exhibit are to be shown the parent organism, *Streptomyces griseus*; the crystalline forms of streptomycin compounds; and culture plates demonstrating the action of the drug on various pathogenic organisms.

National Roster of Scientific and Specialized Personnel

Washington, D. C.

Booth No. 188

The National Roster is a division of the U. S. Employment Service, Department of Labor. The functions of the National Roster are to maintain a national central registration of the Nation's scientifically trained personnel, to provide a placement service for scientific professional personnel and employers of such personnel, and to serve generally as a clearing house of information concerning the sciences and professions. At present a major portion of the Roster's placement efforts are devoted to locating suitable civilian positions for returning veterans qualified in the professions. During the war the Roster's efforts were devoted almost entirely to the mobilization of scientific and technical personnel in both civilian and military positions and participation in the deferment program. The Roster's exhibit will include copies of its various occupational publications and statistical information on various professions, and will show how the Roster's work is carried on. A representative of the National Roster will be present to answer questions and provide information.

St. Louis University Biology Department and Biodynamic Laboratory

St. Louis, Missouri

Booth No. 42

Study of ultrarapid cooling. When a substance which contains water is cooled very rapidly—that is, at a velocity of several hundred or a thousand degrees F. per second—*ice cannot form freely in it.* Either no ice is formed or very little, depending on the velocity of cooling and on the amount of foreign material dissolved in the water. There is some evidence that such rapid cooling does not harm living beings. Prof. B. Luyet, of St. Louis University, and Dr. P. M. Gehenio, of the Biodynamic Research Laboratory, have developed methods for recording the quantity of ice formed during ultrarapid cooling in droplets of solutions or of body fluids several hundred times smaller than those delivered by a medicine dropper. Small organisms were also investigated. The exhibit will include a demonstration of the methods and a presentation of the apparatus and the records.

Science Illustrated

New York, New York

Booth No. 72

This booth is designed as a general meeting place for those who are attending the Association's meetings to get together and discuss the various aspects of the advent of the new mass magazine, *Science Illustrated*, the purpose of which is to report the developments of the sciences to the general public and to describe their consequences in terms of daily living. Dr. Gerald Wendt, editorial director, will be on hand personally a good part of the time; and other members of the magazine's staff will be in constant attendance, ready to answer questions and demonstrate the editorial aim of this new magazine, illustrating from copies of the first issue which will be rushed from the press to the convention several days in advance of issue date.

Science Service

Washington, D. C.

Booth No. 181–182

The exhibit will show the variety of work done by Science Service in the popularization of science. This includes services to newspapers—*Daily News Report, Wire by Mail, Science Page, Your Health—Here's How, Star Map, Science Shorts,* and *Isn't It Odd?*; *Science News Letter,* the weekly summary of science covering new developments in 137 science subject classifications; *Chemistry,* the monthly magazine of new developments in chemistry, edited to serve intelligent laymen, industrialists, teachers, and students of science; *Things of Science,* the monthly kits of practical exhibits, experimental materials, and instructional information in what is new in science; *FUNdamentals of Science,* the kits designed for 10- to 15-year-old experimenters, containing all the apparatus necessary for carrying out dozens of experiments, for which careful directions are given; books edited and published by Science Service; magazine articles by members of the staff; *Science Clubs of America,* the materials now being sent at no cost to the more than 9,000 sponsors of clubs affiliated with Science Clubs of America, the international organization for young scientists, which now numbers more than 200,000 members; *The Annual Science Talent Search* for the Westinghouse Science Scholarships, conducted by Science Clubs of America, which is an open competition to high school seniors; *Science Clubs of America Cooperators,* the work of the 32 cooperating organizations now working with Science Clubs of America to provide opportunities for young scientists in 28 states; *Adventures in Science,* a weekly nation-wide broadcast by Science Service over the Columbia Broadcasting System, a portion of which is devoted to an open meeting of Science Clubs of America; and *Science News of the Week,* a compilation of the scientific developments of the week which is prepared for use by any radio station. Members of the staff of Science Service who will be present at the meeting include: Watson Davis, director; Dr. Frank Thone, staff writer in biology; Miss Jane Stafford, staff writer in medicine and health; Miss Marjorie Van de Water, staff writer in psychology; and Miss Margaret E. Patterson, secretary, Science Clubs of America.

Letters to the Editor

A Plea for Stabilized Progress

Government inevitably reflects the mind of Main Street. Among the laymen, and therefore in government circles, the practical aspects of atomic fission appear to have produced four characteristic, if not correlative, reactions: (1) a vague, yet realistic, fear; (2) concomitant or subsequent attempts to escape from reality by clinging to national and local tradition; (3) a consuming interest in the mechanics and destructive potentialities of the bomb; and (4) futile gestures toward keeping secret the methods of manufacture and design.

There is considerable likelihood that these elements of reaction may combine to swing the pendulum of science from obscurity to sustained and revered leadership. Scientists may be lavished with all the respect and eulogy previously accorded generals. It is pertinent, therefore, that we be prepared to advise the public politically before the first limelight fades. Profs. Einstein, Urey, and others have already indicated the dire necessity for world government as the only plausible defense against the atomic bomb. But how to implement a solution of the social and organizational problems involved? We vaguely and categorically satisfy ourselves with the ends and leave the means to "society," "politics," or other social abstraction.

Our logical co-worker in this regard is the social scientist, for his background consists of the history of human relationship and a knowledge of present social conditions and trends. His equipment for dealing with outworn and positively dangerous traditional thinking should be ideal. Perhaps he can shed light on the problems necessarily accompanying, and peculiar to, the establishment of permanent peace.

Raymond E. Bassett (*Science*, 1946, 103, 25–26) confirms the similarity of method inherent in sociological, and in physical, biological, and medical investigations. Mutual cooperation, therefore, could be maintained on a common footing to the ultimate satisfaction of both groups, and a coordinated solution to world problems might be effected.

In order that science may proceed on a comprehensive and safe basis, it seems not unreasonable to suggest for the two scientific groups a 50–50 relationship. This would involve an equal sharing of government appropriations, a more equitable distribution of offices within the more broadly constructed scientific societies and organizations, and unremitting requests to the public and Government for impartial support of scientific projects, regardless of social or physical classification.

Unfortunately, with the rapid and not always well-deliberated shifting of public opinion, physical science may become a disproportionate public fad, and the social scientist may be lost in the shuffle.

R. J. Cordell

Minersville, California

Broadcasting Congressional Sessions

A continuous radio broadcast of all open Congressional proceedings would do more than almost anything else to intelligently arouse, enlighten, and interest the American people in the preservation of the American way of life.

We have the technical power to place a microphone at every congressman's desk and provide a place on our radio bands for democracy in action at its roots. The cost involved would be trivial compared to the value to our country.

If those men of science who approve of this plan would approach their governmental representatives and radio executives and interest their friends in doing likewise, considerable influence would be directed towards the attainment of a continuous radio broadcast of all Congressional sessions.

Maurice J. Kelley and Ralph G. Schaubhut

Industrial Research Laboratory
National Oil Products Company
Harrison, New Jersey

Federal Aid for Scientific Research

The importance of federal aid for scientific research is again stressed by publication in the *New York Times* (14 February) of a "top secret" letter from German Grand Admiral Karl Doenitz admitting, in the fall of 1943, that American and British scientists had defeated the U-boat campaign through "superiority in the field of science." He said: "It is essential to our victory that we make good our scientific disparity and thereby restore to the U-boat its fighting qualities."

While scientists are practically unanimous in favoring federal aid for research, many are apt to be misled by idealistic declarations in the preambles of proposed legislation or in the statements of Committees, and thereupon assume that whatever the bill itself proposes, or the small executive group of the Committee decides upon, will really be helpful in attaining the ideals advocated. While nominally having the right of criticism, many, if not most, of these well-meaning persons fail to consider in detail what is actually expressed or implied in a bill, and may thus find themselves used as "rubber-stamp" sponsors for practical results which, on sober reflection, they would abhor.

After securing a copy of the bill S. 1720 and making a careful analysis of it, I read (*Science*, 1946, 103, 161) that S. 1720 is undergoing final redrafting; so that perhaps my comment may be moot. But I cannot take the naive view (expressed in *Science*, 1946, 103, 104) that techniques of administration are unimportant. As I understand it, S. 1720 places very great power and financial patronage in the hands of appointees and appointees of appointees. Even though Sec. 4 *(f)* of S. 1720 says that all "officers and employees of the Foundation, shall be chosen without regard to their political affiliations and solely on the basis of their demonstrated capacity to carry out the purposes of the Foundation and their fitness to perform the duties of their office,'' even scientists should know enough of practical politics to realize that those making appointments can always find ''fit'' persons among the ''deserving'' of their political views. The fine objectives of this movement for federal aid to science might easily be perverted or even blocked should the control of the funds or their administration get into the hands of the wrong persons. Selection of key personnel by nonpolitical scientific groups is a wise and even essential safeguard. The Federal government already has many thousands of scientists in its employ—about 40,000 according to the last estimate I saw.

JEROME ALEXANDER

50 East 41st Street, New York City

In Support of a September Meeting of the AAAS

We wish to add our support to the suggestion made by Prof. R. S. McEwen (*Science*, 1946, 103, 178) that the AAAS meetings be held at a season other than the Christmas holidays. As Prof. McEwen says, attendance at winter meetings is usually made disagreeable by bad weather, crowded trains, colds, and disrupted family gatherings. Furthermore, there is no reason why biologists should have to spend their short winter vacation attending scientific meetings, while chemists, physicists, and various other professional groups schedule and attend their meetings with little regard for college teaching schedules. On the whole, it seems that early September might be the best time for a meeting. An objection might be raised by some biologists who work up the results of their summer's research during the autumn and present them at the winter meetings, but this objection is minor and could usually be overcome. Let us give serious consideration to Prof. McEwen's suggestion and try another September meeting.

RUTH M. ADDOMS, LEWIS E. ANDERSON, H. L. BLOMQUIST, PAUL J. KRAMER, HENRY J. OOSTING, H. W. PERRY, and F. A. WOLF

Duke University

Radio Echoes From the Planets

The recent announcement of the reception of radar echoes from the moon have aroused interest in, and raised inquiries concerning, the absorption of microwaves by those gases which are present in the atmospheres of the various planets. A general investigation into the microwave absorption has been made at these Laboratories and some results presented before the New York section of the American Physical Society (*Phys. Rev.*, 1945, 68, 284). It was found that of the 50-odd substances which are gases at room temperature and pressure, 15 strongly absorb microwaves. Absorption may be characterized as either resonant or nonresonant. In methyl fluoride the absorption is largely nonresonant. At a wave length of 1.0 cm. this gas at normal temperature and pressure will reduce the power in a plane wave by 50 per cent for each 23 feet of gas traversed by the wave. At 3.0 cm. the absorption is 75 per cent as large as it is at 1.0 cm. Ammonia, on the contrary, exhibits resonant absorption, with the maximum in the curve under the above conditions occurring at 1.25 cm. while at 3.0 cm. absorption falls to 20 per cent of its maximum value. This gas is found in the atmospheres of both Jupiter and Saturn. It might be thought that considerable information would be given by varying the frequency of the radar transmission, but this is not the case. Owing to the high gas pressures found on these planets and the presence of other nonabsorbing constituents in their atmospheres, the width of this absorption region is so great that it is likely that both microwaves and waves in the ultra short radio spectrum will be totally absorbed in the atmospheres surrounding these planets. The transmission paths involved in radar sounding are so great that a very small absorption coefficient will give rise to total extinction. The results of further radar experiments should prove of value in increasing our knowledge of the constitution of planetary atmospheres.

For the information of those who are interested, the list of gases showing large absorption for microwaves includes the methyl and ethyl halides, the gases known commercially as Freon, three of the amines, ammonia, and sulphur dioxide. In fact, all nonplanar molecules having a dipole moment which have been tested thus far in the Laboratory show strong absorption in the microwave region, and in general this absorption is of the nonresonant variety.

W. D. HERSHBERGER

RCA Laboratories, Princeton, New Jersey

Competition Between Two Entomogenous Bacteria

The antibiotic activity of *Bacillus larvae*, the causal organism of American foul brood of the honeybee, was recently reported by E. C. Holst (*Science*, 1945, 102, 593–594). A phenomenon suggesting antibiotic activity is to be found in two other entomogenous bacteria, *Bacillus popilliae* Dutky and *Bacillus lentimorbus* Dutky, the causal organisms of two types of milky disease of Japanese beetle larvae. The vegetative forms of these two bacteria are similar in appearance, but the spore forms are readily distinguishable. The bacteriemic infection of the host is very similar in the two cases. Neither bacterium has been cultured artificially with any degree of success.

Both types of milky disease, described by S. R. Dutky (*J. agric. Res.*, 1940, 61, 57–68) and designated by him as Type A (*B. popilliae*) and Type B (*B. lentimorbus*), can be individually induced in host larvae by injection into the body cavity of adequate numbers of the respective bacterial spores. Both types of bacterial parasitism, however, do not occur in the same host individual. If a mixture of *B. popilliae* and *B. lentimorbus* spores is injected into a host larva, only Type A or Type B develops —not both. The relative spore dosage largely determines which type is successful. In most cases, Type A develops, but if the number of *B. lentimorbus* spores injected greatly exceeds the number of *B. popilliae* spores, Type B may develop. Under certain other dosage conditions Type B will develop at the expense of Type A. Time also is a factor. If *B. lentimorbus* spores alone are injected into host larvae, and two days later *B. popilliae* spores are injected into the same larvae, growth of *B. lentimorbus* alone occurs except when larger dosages of *B. popilliae* are used. In the latter case the time advantage is overcome, and Type A milky disease will develop. If *B. popilliae* is given the time advantage, only Type A develops.

In direct competition, *B. popilliae* seems more potent than *B. lentimorbus*, but it is not necessarily more infectious upon injection. When spores of the two bacteria are separately injected into host larvae, fewer spores of *B. lentimorbus* than of *B. popilliae* may actually be required to cause a given rate of infection.

The effect of *B. popilliae* and *B. lentimorbus* on the growth of other microorganisms has not been investigated, but antibiotic activity might explain the mutually exclusive development of these two types of milky disease in Japanese beetle grubs. This is offered only as a suggestion until more is known of the physiological action of these two bacterial parasites. A more detailed account of the competition between *B. popilliae* and *B. lentimorbus* will be published at a later date.

R. L. Beard

Connecticut Agricultural Experiment Station, New Haven

Relief Packages for Scientific Workers in Western Europe

Several of us have recently often been asked for information about the needs of our colleagues in Western Europe, about the most suitable things to send them, the best way to send these, etc. It seems, therefore, that it may be useful to broadcast the following information:

(1) There is still a serious shortage of food in all countries of Western Europe which have been occupied by the Axis. Though conditions have improved considerably since the liberation of most of these countries, the amount of calories and vitamins which our colleagues and their families receive is very often still inadequate, and, moreover, it is nearly always given in forms which are dreadfully monotonous.

(2) Scientists in North America who feel a desire to assist their colleagues in Western Europe by sending one or a few relief packages should not hesitate to do so and should do this in the near future. If one has had dealings in the past with an outstanding colleague, one should most positively not be afraid to embarrass him with a gift package. If he does not need it, which is not likely, he will turn all or part of the contents over to one of his associates who may need it more. Packages can also be sent addressed to: The Staff, ——— Laboratory, University of ———.

(3) It is advisable to use the folding boxes sold at Woolworth's and similar stores for sending packages to men in the armed forces serving overseas (size, about 8″ × 12″ × 15½″). Experience has shown that these comparatively small boxes go through much quicker and stand up much better in transit than larger boxes. Fill boxes as tightly as possible and wrap each article in kraft (better than newspaper). After the box has been filled and small openings have been closed with such useful things as matches, pins, adhesive tape, razor blades (all wrapped in kraft), it is best to close the boxes with gummed tape. The entire box should then be wrapped in strong kraft. It is well to put an address directly on the box and one outside on the package. Close with twine (not tape) and tighten well. Only articles which are dry or have been packed in well-closed tins should be sent. Glass jars should never be sent.

Cigarettes (unless already wrapped in cellophane), soap, tea, etc. should be wrapped first in wax paper and then in kraft.

(4) Though it is not possible to give ironclad rules concerning the things most needed and appreciated, it is safe to assume that the following things will be particularly welcome: canned meat, canned vegetable fats, canned butter, canned peanut butter, sweetened cocoa (much better than unsweetened), tea (takes less space than coffee), coffee (now again available in tins), soap (toilet soap or Ivory, scentless), toothbrushes, tooth powder (less risky than tooth paste), razor blades, shaving cream (sticks), needles, safety pins, pins, yarn, thread, shoe soles, shoestrings, elastic (very much needed!), matches (wrap in kraft and use to fill small spaces in packages), etc. Dried fruits such as raisins, prunes, figs, and dates are always welcome, as well as hard candy (often safer to send than chocolate).

Cigarettes are in many cases more welcome than anything else; they are still often used for unbelievable exchanges for goods or services. Some colleagues prefer tobacco (now again in tins) or cigars (should be individually wrapped in cellophane).

Colleagues with children will appreciate milk powder, seedless raisins, and an occasional toy.

(5) Postal regulations permit the sending of one package a week to one addressee. Packages should be clearly marked: "Gift—Limited Value." Here follows a list of countries with some information concerning rates, customs forms needed, and limit of weight per package.

In the following countries the limit of weight per package is now 11 lb., the cost 14¢ per lb., and Post Office Forms 2966 and 2922 must be filled out and attached to the package: *Norway, Denmark, Finland.*

Poland. The limit is 11 lb.; 14¢ per lb.; forms needed: Nos. 2966 (two copies) and 2922.

Netherlands. The limit is 11 lb., 14¢ per lb.; forms needed: Nos. 2972 and 2922.

Netherlands Indies. Small packages cannot be sent to the Netherlands Indies, but small cases can be shipped via Messrs. Funch, Edye and Company, Inc., 25 Broadway, New York 4, New York, from whom further particulars may be obtained.

Belgium. The limit is 11 lb.; 14¢ per lb.; forms needed: 2966 (two copies), 2972, and 2922.

France. The limit is 11 lb.; 14¢ per lb.; forms needed: 2966, 2967, 2972, and 2922.

Italy and Greece. The limit is 11 lb.; 14¢ per lb.; forms needed: 2966, 2972, and 2922.

Yugoslavia. The limit is 11 lb.; $1.83 for 11 lb.; forms needed: 2966 and 2922.

Czechoslovakia. The limit is 11 lb.; $1.70 for 11 lb.; forms needed: 2966 and 2922.

England. The food situation in England (11 lb.; 14¢ per lb.; forms needed: 2966 and 2922) has not been too good lately, and in some ways it is worse than it was during the war years. Rationing is said to function smoothly and honestly, but the diet is limited and dull. Conditions are not in any way as bad as they are in most countries of Western Europe, and packages should chiefly be sent to colleagues with whom one has had relations for a longer time.

There are a number of firms which make up gift packages for shipping to the countries overseas. They are often in a position to send such things as butter in tins, which an individual cannot easily obtain. A reliable firm is: Fraser, Morris and Company, 119 West 57th Street, New York 19, New York, which will send a price list upon request. The Universal Tobacco Company specializes in sending cigarettes, cigars, and tobacco overseas (276 Fifth Avenue, New York 1, New York).

(6) After sending a first gift package, one may inquire if the colleague to whom it has been sent does not have any special needs. Many are in desperate need of things which are easily and cheaply available in the USA, such as slides, cover glasses, certain stains, one or two recent books, rubbers for a child, a hotwater bottle for an aged member of the family, hose, or underwear, etc. Medicines are now mostly available in sufficient quantities. Letters received from colleagues to whom gift packages have been sent should be considered as personal communications and should never be published in full without the writer's consent.

(7) The governments of most of the countries of Western Europe have been acquiring scientific periodicals and also often books published during the war years in the Americas and the United Kingdom. This literature is now being forwarded and will be distributed in due time amongst the largest libraries. All this is, of course, only a drop in the bucket. Many colleagues are in great need of literature. In most cases they can send older books in exchange or they will be able to pay for books sent, within a year or two.

Publishers and managers of scientific periodicals should be liberal in allowing their former subscribers one or two year's credit during the years of the early reconstruction period in Western Europe. When the Nazis left, the financial structure of these countries was in a deplorable state.

But not only scientific literature is needed. "Pocket books" of the better kind can easily be included in gift packages. A few numbers of *Time, Life,* or *Newsweek* will find many grateful readers, and a gift subscription to one of these magazines would be very welcome.

FRANS VERDOORN

Chronica Botanica, Waltham, Massachusetts

comprehensive texts

hoeber book news

Adams

INTRAVENOUS ANESTHESIA

FIRST definitive study of intravenous anesthesia—complete review of the literature and practical manual on how and when to use it. Includes dosage, administration, induction and maintenance phenomena, and systemic effects, for man and animals. All useful drugs are carefully evaluated, particularly pentothal sodium, which Dr. Adams has used in 50,000 Mayo Clinic cases. Invaluable for all, this book answers every question, solves every problem about one of the most discussed scientific topics today.

677 pp., 75 illus., $12.00

Thienes

FUNDAMENTALS OF PHARMACOLOGY

CONCISE, authoritative, bringing the body of knowledge up-to-date, correlating it with modern scientific and therapeutic needs. *All important U.S.P.XII preparations are included!* Major emphasis is on drug action dynamics, and the absorption, distribution, metabolism and excretion of those drugs which form the basis of modern medicine. Vitamins and hormones, penicillin, propadrine, and dicumarol . . . every recent development is covered in detail. Convenient reference for all.

535 pp., 36 illus., $5.75

convenient order blank

Sci. 46

PAUL B. HOEBER, INC., ***Publishers***
Medical Book Dept. of Harper & Brothers
49 E. 33rd St., New York 16, N. Y.

Send me: ☐ ADAMS ☐ THIENES

☐ On Approval ☐ C.O.D. ☐ Check encl.

Name .... Address ....

Book Reviews

Studies in biophysics: the critical temperature of serum (56°). Lecomte du Noüy. New York: Reinhold, 1945. Pp. vi + 185. (Illustrated.) $3.50.

The group of closely related experimental researches described in this monograph include much of the available data to justify the author's point of view that "serum is a complex, fragile liquid." His contention is that it must be examined "kinematically" in order to obtain a true picture of its biological properties. Quantitative results were attained by refining old techniques of measuring viscosity and surface energy, and creating new ones by employing optical precision methods for determining the absorption and scattering properties of serum near its inactivation temperature (56° C.).

The evidence points to profound modifications taking place in the structure of the proteins, and of the lipoprotidic complex around 56° C. Du Noüy concludes that it is through the systematic further study of the "serum molecules" possessing immunological properties, and of the globulin fraction of the serum, that rapid progress in immunological problems will be made.

The Introduction is followed by 11 chapters discussing adsorption (monomolecular layers), viscosity, rotary power and dispersion, absorption and scattering, coagulation by heat, sedimentation, electric conductivity, hydrogen ion concentration, fixation of ether by serum, interfacial tension, and ultraviolet absorption. Detailed data and graphic results are presented to show how these properties vary with changes in temperature. Variations around 56° C. are discussed in detail.

To the physicist who is teaching biophysics this is recommended as an excellent source for illustrative material. To the biologist and medical scientist it can be recommended as an example of the biophysical approach, which the basic biological research of the future must follow to attain its ideal quantitative goal.

The author's distinguished contributions in this field are in themselves a more than sufficient insurance of the value of the monograph.

OTTO STUHLMAN, JR.

University of North Carolina, Chapel Hill

Principles of radio for operators. Ralph Atherton. New York: Macmillan, 1945. Pp. x + 344. $3.75.

This book is the outgrowth of the author's experience in training Navy men and women as radio operators. Its 16 chapters were assigned, one chapter per week, during a 16-week course. The subject matter is well selected for this purpose. Each chapter includes descriptions of appropriate demonstrations and experiments as well as review tests and lists of available films for visual-aid instruction. The general plan of instruction is excellent.

In general, the discussion of batteries, meters, and radio apparatus is superior to that of fundamental electrical theory, motors, and generators. Weaker chapters are due, in part, to a loose and often confusing style of exposition. The better chapters are well written.

Chapter 5, "Motors and Generators," is particularly inadequate in view of the importance of rotating machinery in radio communication. Some explanations are not clear and appear erroneous. In places, even a well-informed reader is not sure what the author has in mind. Students, for whom the book is written, will find portions of this chapter obscure and confusing. With the exception of one sentence on the starting-box for d-c motors no mention is made of motor and generator starting and protective equipment. A-c machinery is passed over hastily and quite inadequately.

A 41-page appendix of miscellaneous information useful to the radio operator is included. Rules on "Safety First" when handling radio transmitters and standard instructions for giving artificial respiration are commendable material. Less justified are the 30 pages devoted to tables of vacuum tube characteristics and socket connections. Such information, while possibly useful to the radio operator in "trouble shooting," is primarily of interest to the designing engineer. The space required for these tables might have been used to better advantage for material to strengthen portions of the text.

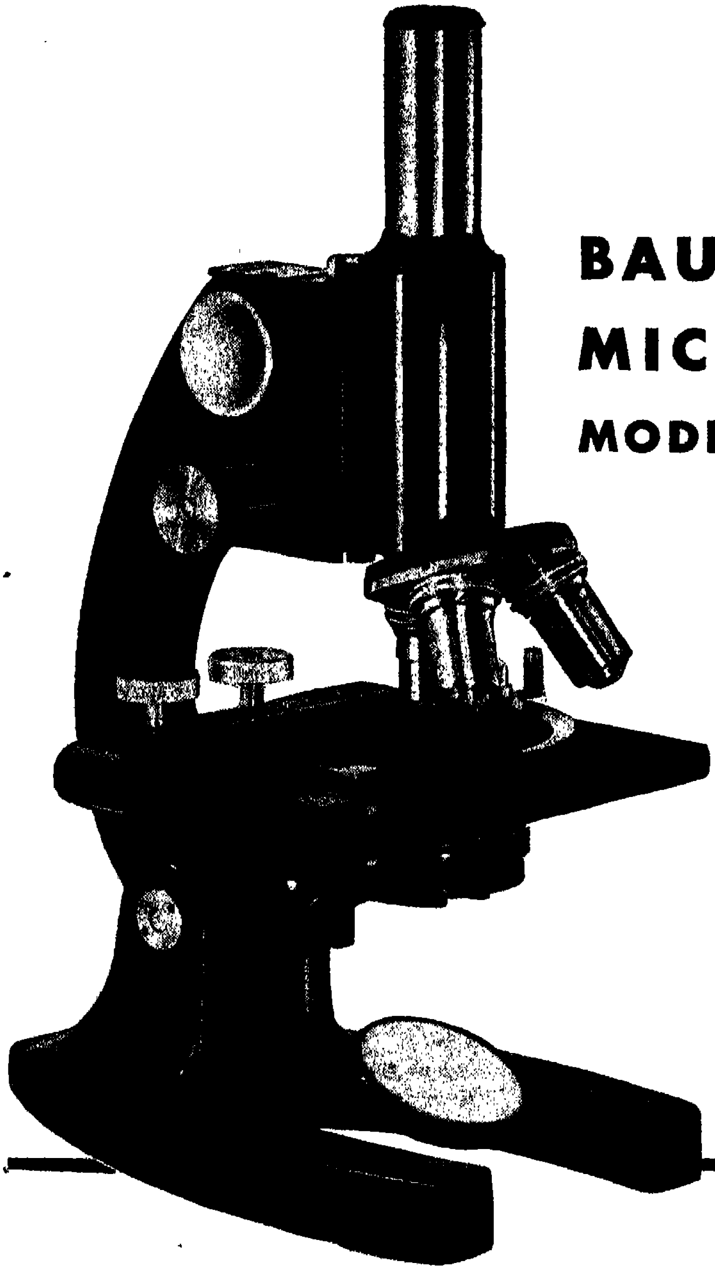
LEONARD F. FULLER

Palo Alto, California

Electronics for engineers. John Markus and Vin Zeluff. (Eds.) New York: McGraw-Hill, 1945. Pp. x + 390. (Illustrated.) $6.00.

This rather unusual book is a collection of 142 articles, reference sheets, charts, and graphs selected by two of the editors of *Electronics* from the files of this trade journal for the past 10 years and reprinted for the use of electronic engineers. The result is a book which is excellent in parts, which covers a wide range of topics, and which has represented a great deal of labor in computation on the part of the authors responsible for the charts and graphs. The faults of the book arise because the editors have restricted themselves to such material as has been submitted for, and accepted by, *Electronics*. This method of selection has unique merits and unique faults. It surely means that, in the opinion of both an editor and an author, the material presented has timely engineering interest. However, the use of such a method insures neither completeness nor uniformity of treatment on any given topic. The quality and worth of any given section of the book is determined largely by the care and judgment used by the authors of the papers making up the section.

The range of subjects treated is wide. The greater portion of the book is devoted to circuit elements, transmission lines, and electric networks intended for specific applications, with correspondingly less emphasis on



BAUSCH & LOMB MICROSCOPE

MODEL BA-8

The B series of Bausch & Lomb Microscopes is planned optically and mechanically to meet the greatest possible number of uses with a standard instrument. In weight, in balance, in range of magnification (from 20X to 980X) and in accessories available, these beautifully built microscopes give you a precision instrument that's truly versatile. Model BA-8 has built-on mechanical stage of improved design. An Abbe Condenser, 1.25 N.A., is held in a full-ring mount. Positive, smooth focusing is accomplished through rack and pinion coarse adjustment and B&L patent lever-type fine adjustment, with automatic take-up for wear. Write for Catalog D-185, "Laboratory Microscopes." Bausch & Lomb Optical Co., 642-3 St. Paul Street, Rochester 2, New York.

BAUSCH & LOMB

ESTABLISHED 1853

vacuum tubes and physical electronics. Thus, there are sections on components such as capacitors, iron-core transformers, permanent magnets, relays, and r-f coils and transformers. In the field of circuit design, there are papers on audio circuits, filters, wide-band amplifiers, and television circuits. Miscellaneous topics treated include pulses, antennas, electronic heating, and industrial control. There are no papers on magnetrons, klystrons, cavity resonators, or wave propagation.

The fact that a topic is of sufficient importance to warrant inclusion in the book by no means indicates that it will receive a well-balanced treatment. Thus, 14 papers deal with transmission lines, including one which describes the extremely useful Smith chart for making line calculations. Lines are treated adequately from an engineering-design point of view. In similar fashion, the treatment of electronic heating is well rounded. By contrast, the broad field of oscillators is dismissed with two papers, both fair: one on phase shift oscillators, and the second on the temperature coefficient of quartz. Few engineers would consider the treatment accorded oscillators at all adequate.

The greatest value of this book arises from the fact that it furnishes to the engineer a wide variety of information in a form convenient for reference. The book is to be recommended in particular to those engineers who enjoy using charts and graphs in making their own calculations.

W. D. HERSHBERGER
RCA Laboratories, Princeton, New Jersey

Human biochemistry. Israel S. Kleiner. St. Louis: C. V. Mosby, 1945. Pp. 573. (Illustrated.) $6.00.

There has long been need for a textbook on biochemistry which presented all the essential facts regarding the subject from the viewpoint of its usefulness in the practice of medicine. The author states in his Preface: "It is not so many years since physiological chemistry was essentially a pure science course in medical schools and reference to clinical applications was incidental if not accidental. . . . The name biochemistry has come half way from the laboratory to the clinic. The student now is shown the subject as an integral part of the practice of medicine—not just as a part of the medical curriculum. He learns that advances in every branch of medicine, surgery, and dentistry, have been made as a result of biochemical research, that the human body *is* applied biochemistry, that the entire field of physiology is a *series* of biochemical *reactions* and pathological phenomena result from disturbances of these same reactions, and that biochemical discoveries are more and more responsible for progress in diagnosis and therapeutics. The present volume is an attempt to bring home to the student these clinical aspects of biochemistry without usurping any clinician's domain and without neglecting the fundamentals." The author would appear to have been very successful in his efforts to attain these objectives, and the book should hold the interest of those students who look forward to the practice of medicine and also stimulate those who vision a scientific career in medicine.

It could not be expected that in this relatively brief book it would be possible to cover fully all the essential facts of biochemistry and to discuss their most important clinical applications as well. However, the author has used excellent judgment in the fundamental biochemistry he has included, although in some cases the brevity may suggest a lack of importance that is not intended. Most departments of biochemistry employ their own laboratory directions. In accord with this the author touches on the principles of only a few of the most fundamental methods. This materially aids in concise and direct presentation of the subject.

Active fields of biochemical research such as enzymes, vitamins, and hormones are excellently presented, while the discussion on carbohydrate, lipid, protein, and mineral metabolism and water and acid-base balance would appear commensurate with the scope of the book. Practical clinical applications of biochemical facts and methods will be noted on nearly every page of the book, but such topics as diet therapy, basal metabolism, changes in the chemical composition of the blood, and recent clinical applications of biochemical methods are given a fuller discussion than is found in most other texts on biochemistry. Presentation of biochemistry from this point of view cannot help but instill in the minds of medical and dental students the usefulness as well as the practical importance of the subject.

In the classification of proteins, in the chapter on proteins, the author omits the third group, "Derived Proteins," given in the usual classification, for the reason that this group includes either denatured proteins or mixtures of protein decomposition products. Although this is true, most biochemists will probably still feel that we need a heading to cover this group of substances. Like many other first editions, the book contains a number of typographical and other minor errors. These will probably soon be corrected and other minor changes made to strengthen the original plan of the text.

The book can be recommended to teachers of biochemistry, especially those who believe that in the presentation of the subject stress should be given to practical applications as well as to fundamental principles.

VICTOR C. MYERS
School of Medicine
Western Reserve University, Cleveland

SCIENCE

Vol. 103, No. 2674 Friday, March 29, 1946

Is There "A Standard to Which the Wise and the Honest Can Repair"?

A. J. Carlson

Professor Emeritus of Physiology, University of Chicago

MY TITLE IS A QUOTATION from George Washington, the "father of our country," who said: "Let us raise a standard to which the wise and honest can repair; the rest is in the hands of God." The question marks are my own. My questions are: Is there such a standard? Can we agree on such a standard? Who are the wise and the honest to rally around this standard? If there be such a standard and if there be any wise and honest men, I would say the rest is in the hands of man, not in the hands of God.

Were I to follow my own dictum that a scientist should keep his mouth shut and his pen dry until he knows all the facts, I would stop with the mere quotation from George Washington. However, on the basis of my understanding of man and my acquaintance with human history, I have also advocated in the past that a man's social responsibility is commensurate with his understanding of man and nature. If that is even approximately correct, we in the natural sciences surely have no less responsibility in the present dilemma of the race than have men in business, industry, and government. The "Atlantic Charter" promised us freedom from want and freedom from fear, if the war against Germany and Japan was waged to victory for our side. We have achieved victory, but our world is now plagued with more want and more fear—and on a larger scale than ever before. This is merely another illustration that war, violence, and destruction are probably not the best means by which to establish relative freedom from want of food and fear of further violence.

Men of science, particularly our colleagues in chemistry, physics, and engineering, are *praised* and *blamed* for producing during this war better and more efficient weapons of destruction, specifically the atomic bomb. This has led, especially in the United States, to plans further to facilitate scientific research through federal-government financing, as a means for greater national security—that is, greater freedom from fear. On the other hand, there are voices, though less loud, charging that science, and the scientists, are primarily responsible for the increasing destructiveness of war and the increasing injurious effects of war on the human race, and these voices call for a moratorium on science and appeal to philosophy and religion for the answer to the dilemmas of the hour.

Before proceeding to discuss the standard George Washington had in mind and the wise and the honest who should rally around this standard, if such a standard can be found, let us dispose of some of the rather superficial accusations, charges, and fears that are current today—yes, even today, when the shooting, at least, of the worst war in human history is over.

Facing these dilemmas, not a few fellow citizens appear to substitute hysteria for history and sentiment for science. As I see it, science is as much and as definitely a part of nature as are the life-giving sunshine and the destructive tornado. To significantly or permanently retard or abolish science, we must fundamentally modify or destroy man, for science, in its final analysis, is the product of human curiosity. But temporary retardation of science can be achieved both by violence and by unwise legal or political dictation in times of peace as well as in times of war, for the processes of scientific research are not as simple as adding fertilizer and water to parched and depleted soils. In the latter case there is no problem of mental and physical freedom of the individual man, the individual scientist.

Address of the retiring president of the American Association for the Advancement of Science delivered at St. Louis, Missouri, on 27 March 1946. Ordinarily this address would have been delivered in December 1945, but due to wartime conditions this meeting was postponed to the spring of 1946.

Scientists are being urged to "knock at the door of politics." Scientists probably should do that, if in so doing we do not deviate from the path of science and continue to stick by the facts. If, when "knocking at the door of politics," we *follow current political mores*, we will injure science and render no service to society. Specific current examples of scientists "knocking at the door of politics" are the endeavor of American scientists to guide and improve federal legislation concerning the National Science Foundation and the organized endeavor of the American chemists, physicists, and engineers responsible for the development of the atomic bomb to foster national legislation having to do with publicity and control of atomic energy in the best interests of the future peace and prosperity of all men everywhere.

Yes, men of science are urged to "knock at the door of politics." I think that our social responsibility compels us to knock at this door, not only as individual citizens but as organized professional people. And yet Sir Josiah Stamp, former president of the British Association for the Advancement of Science, says: "The training of the scientist includes no awareness of the social consequences of his work, and the training of the statesman and administrator no preparation for the potentiality of rapid scientific advance and drastic adjustment due to it, no provision of the technical forces which are shaping the society in which he lives." Perhaps our "knocking at the door of politics" will be relatively futile until leaders in politics understand the scientific methods and the ethics of scientific research.

According to my best recollections, the standard which George Washington asked us to raise over a hundred years ago was not specifically described, but it undoubtedly related primarily to political, economic, and religious freedoms such as we usually designate under the term democracy. Certainly that standard, even raised by a leader of a rebellion, stands for peace rather than war as the human ideal toward which we must labor with all our knowledge and courage. We may also assume that George Washington's *standard* embodied the "golden rule." But as formulated by leaders of our race in the more distant past, the golden rule seems too utopian for man at the present stage of intellectual and social evolution. In international relations we usually follow the golden rule in reverse. We do unto others what we fear they are about to do to us; and if our enemy hungers, we starve him some more. But man today seems capable of such realistic application of the golden rule as is seen in open conferences, fair compromise, and honest cooperation. In international relations this formula seems at present the only substitute for war. Given even moderate understanding and integrity in our political leaders, this procedure does not seem beyond human capacity of any race or nation today.

But is peace, as opposed to war, a possibility for the human race? It is a fact that some statesmen, some soldiers, some philosophers, and some fellow scientists say that intermittent wars are as inevitable as a part of man's struggle for existence and as nature's crude way of eliminating the less fit. If that is true, a standard looking toward a more durable peace among the human race is certainly not a standard to which the "wise and the honest can repair." That standard, the inevitableness and perennial perpetuity of war, is, of course, clearly opposed to the plan and, I hope, the efforts of the United Nations. If war is inherent and inevitable in human nature, all efforts in the plans of the United Nations are a sham, a delusion, and a snare. I, for one, do not accept this view as a scientific fact or as one rendered probable and inevitable by scientific facts; for war has been gradually eliminated between families, tribes, and even larger groups. To be sure, we still have violent revolutions within individual nations, where it is not a matter of threat or force from without, or matters of difference in religion, race, or skin color. But in recent years, at least, and where empires cover a large part of our globe, wars are violence between nations. Eliminating this last step may be more difficult, but biologically not less possible, than eliminating war between families and tribes.

If it is true that primary drives toward war and violence are greed, vanity, and fear, it may be argued that wars are inevitable as long as greed, vanity, and fear are not controlled or somehow checked by understanding, intelligence, and a growing sense of justice. I think mankind should reckon with this fact. The control of greed, vanity, suspicion, and fear by understanding and intelligence is going to be a slow process, even through modern travel, communication, and education, as long as modern communication and education are partly sidetracked toward increasing greed, suspicion, and fear. I think we can be more positive, however, in answer to those fellow citizens (industrialists, politicians, and scientists) who argue and find comfort in the supposed fact that war is beneficial to the human race in the sense of survival of the fittest and elimination of the less fit. In modern times the less fit physically and mentally are not drafted into the armed forces in any nation, except under extreme provocations. Hence, death and mental and physical injuries in the armed forces in war falls on the physically and mentally more fit of a nation's population. As we now wage war, not against the armies and the navies of the enemy, but against men, women, and children of enemy countries, everyone can clearly see that atomic and other bombs, gunfire, poison gas, flame throwers, etc., do not discriminate between the fit and the less fit; the same is true of the sequelae of war: *starvation* and *epidemic disease*. In other words, modern war tends to render even the most fit less fit in body and mind for the functions of peace in every nation. Even with the partial understanding of the nature of man and the universe available during the last hundred years, it has been possible for some of the small nations to change from war to planned and persistent peace, by their own understanding and choice, even without the aid of an international police force, as is now being planned by the United Nations. My own forebears, the Scandinavian vikings, were not so long ago the scourge of Europe, warring, killing, and robbing in every accessible land. The descendants of these warriors have not waged war voluntarily for over a hundred years, but have used their energy and understanding in the arts of peace without, so far as we can judge, suffering national degeneration. Of course, on this latter point, a hundred years is but a pilot experiment. Finally, we now know enough of the role of heredity and health in mental and physical fitness to control the population percentage of the less fit more humanely and with less injury to man and nature than is done by war.

Who are the wise and the honest in the population, and who am I to indicate who the wise and the honest might be? We usually regard as honest a person who does not knowingly tell or report as facts what he knows not to be so or who does not leave out in his speech or writing some essential which actually changes the meaning or significance of what he does tell or report. It is in this sphere that men in science have, or should have, greater experience, training, and conditioning than the rest of mankind, because the scientific method and scientific research demand absolute integrity, the absolute sticking to the facts as known or discovered. This does not mean that the scientific investigator is by heredity more honest than other fellow citizens. It merely means that science and dishonesty do not mix—they are incompatibles. The scientific investigator who lies is soon found out and discredited by his fellow workers. It is less easy to do such checking, such discrediting, in other fields of human endeavor.

This necessity for honesty, absolute personal integrity, and the reporting of all discovered facts as found without their being colored by wish or hope, should aid the scientist in following the same mental processes in the common life about him and in national and international affairs. I need not tell this audience that this does not always happen. After all, a scientist is a human being first and last and is subject to the same emotions, to the same national and international political pressures, fears, and hopes as are other human beings. All we can hope for ourselves is that we apply a somewhat larger element of the integrity, gained in science, in our common life as citizens of our nation and of the world.

The definition or designation of the *wise* is a more difficult task. That adjective implies wide factual knowledge and understanding, relative unselfishness, and a willingness to apply this understanding to problems where factual data are lacking. Human wisdom fails most conspicuously in passing judgment and acting on immediate needs, *and in neglecting the distant consequences.* This is intellectual shortsightedness—mental myopia. Man—that is, the human race—has dwelt on this earth at least a million years. It seems to me it is high time that those who would be wise should look ahead as to the consequences of their individual, national, and international actions, not only today and tomorrow, but a hundred, a thousand, a hundred thousand years ahead. As I see it, the person who has developed some control of his greed, his vanity, and his fears; who has developed to the limit of his brain the accumulated understanding of man and the universe, and who thinks in terms of his fellow men—the human race—not for the day, tomorrow, or even the next hundred years, but for a future at least as long as our human past; and who at the same time uses all his influence, without violence or coercion, to prevail on his fellow men to follow his example, is entitled to the connotation *wise*. We may then, even though dimly, select a standard and invite the wise and the honest to rally around it, even should this rally reveal but a corporal's guard in every land.

In my humble opinion the element in human nature and modern life forming the greatest obstacle to international peaceful cooperation, and hence the greatest force toward war, is dishonesty—lack of individual, national, and international integrity. This audience need not be told that guile, deceit, and double-dealing constitute the accepted international morality in all nations, though it is never put as honestly and baldly as I have just spoken. It usually takes the form of artistic lying. As long as this unfortunate behavior prevails among leaders in industry, trade, and politics, and in their international relations, it is difficult to see how genuine democracy can work, except by accident, or how genuine cooperation can be achieved in the international field. For example, we pretend to be shocked when it is reported as a "discovery" that other nations maintain spies in our midst. In spreading the publicity and pretended horrors and wrath over such behavior, we forget to reveal that most, if not all, large nations, including our own, do just that thing in war and in peace. I, for one, fail to see how individual citizens in democratic nations or how individual nations in the United Nations can be held responsible for unwise, unfair, or violent actions when the political leaders in these nations and in the new United Nations do not put all the cards on the table, face up, as is done in science.

We Americans profess the ideals of democracy at home and endeavor to spread these ideals in other lands, and yet we agreed to set up in the United Nations a plan by which one of the five so-called great powers can block any action against the violation of the principles of democracy, justice, and fair play on the part of any one of these five larger nations. This is, of course, autocracy—not democracy, but perhaps this halting way is the only path for a hopeful start. I say "hopeful," because we must consider that some day in the future the leaders of these five great powers will be men of greater wisdom and integrity, men of wider and longer vision, than the political leaders in these nations today. When that day arrives, the responsible leaders will be superior to the present plan, and the plan itself will be a dead letter.

In my humble judgment the now defunct League of Nations failed to promote world peace and prevent the most devastating world war in human history, not so much because of faults in plans and powers of the League or because of the fact that our own country did not join the League, but because of lack of real faith in the League—that is, lack of integrity in the leaders of the dominant nations in the League. To them the League ideals and plans were just window dressings behind which the old game of national pride and national power politics went on as of yore. I fear seriously that this same lack of national and international integrity infests at least some of the leading powers of the United Nations. I see no other explanation of the supposed serious adherence of the five leading powers to this new international organization, parallel with the evident start of an individual armament race by the same major nations—an armament race starting, at least so far as plans go, before the guns of World War II even had time to cool. It seems clear to me that the United Nations' efforts toward world peace and the armament race and old-style military alliances of the five leading world powers are definitely incompatibles. International cooperation on the basis of the prevailing ethics of past and current international diplomacy is a delusion and a snare. Honest men with average understanding cannot even hope that it will be effective. Mr. Winston Churchill, coauthor of the four freedoms of the Atlantic Charter, now appears to identify peace with military force, and he asks for military alliances against a resurgent imperial aggression by Russia. We may well ask: Are military alliances in support of empires already built by force any less injurious to the human race than are such military alliances for building new empires by military force? History seems to show that, in the long run, neither are in the best interest either of the masters or of the slaves. The political leader of a great and friendly nation said recently that future peace demands that we treat our fellow men in every land as brothers. At the very hour this political leader made this humane and biologically sound proposal his own soldiers were killing their fellow men in the speaker's own imperial colonies. Killing these people for what crimes?—for the crime of demanding the very freedoms which the people in the speaker's homeland achieved centuries ago. To me, this does not make sense. It adds up to lack of integrity, for this political leader is not a moron.

We Americans insist, and I think justly, that Japan give up all political and commercial control secured by force on the continent of Asia, but we are rather silent about Great Britain's control of part of China, a control also secured by force. We considered the Japanese control of islands in the mid-Pacific Ocean as a menace to our security. Now we propose to retain control of islands at the very door of China and of Japan. We insist that we are a peaceful people, yet we have waged three major wars in less than 50 years. Can we expect other nations to forget that fact? Is it not true that actions are more convincing than mere words?

Many fellow scientists and not a few citizens in the professions, in education, in industry, and in government appear to think that current false ideas and conceptions of *race* are serious causes of fear and hatred leading to violence and war. The science of biology and anthropology has clearly made out that, despite differences in skin color, anatomic details, language, culture, and religions, *the present human race on the face of this earth is biologically one species.* We have no sound scientific basis for the belief or the superstition of superior and inferior races of men. I am the last one to deny that the superstition of national inferiority or superiority has in the past been one of the causes of violence and war. But we have had civil wars in nations of very great racial homogeneity, nations with identical language, customs, religion, and traditions. We have had many wars between nations where there can be no question of fundamental racial differences, such as between Germany and England, Germany and France, Italy and France, Poland and Russia, China and Japan, etc., etc. The realization on the part of all men that the present human race is one species will by itself not abolish war. However, it should aid in this direction, and I should be the last one to minimize the importance of this aid toward a more durable world peace.

Many colleagues put great faith in better education, more universal education of all people in every land, as a prophylactic against future wars. As in the case of the problem of race and human unity, I should be the last one to minimize the importance of education, particularly if this could embrace an understanding of the folly and the waste of war, the value and necessity of human cooperation and fair play, the immediate and the long-range injuries to man from modern wars. But education itself is not the cure-all, is not the universal panacea. Men in every nation with the best education that modern understanding has been able to contrive have become war mongers and warriors by the old urges of greed, vanity, fear, and actual or alleged industrial needs. However, education rather than propaganda is one of our means towards a better day, and we should give our fullest support to the United Nations' Educational, Scientific, and Cultural Organization. It is obvious, however, that this must be factual education rather than propaganda—that our cultural emissaries to other lands, or in the service of the United Nations, should look at themselves and their own nations in the mirror of current and past history as frequently as they look at the errors and mistakes of our fellow men in other lands. In the last 50 years men in the natural sciences have had no difficulty in understanding, in fully appreciating the efforts of, and meeting on common grounds with, fellow scientists from every nation of the earth. In the natural sciences, at least, we do not need so much additional practice in fair and humane international relations with our fellow scientists. In saying that, I do not point a finger at other fellow citizens with fewer international contacts than the natural scientists; for, after all, we meet on the common ground of controlled facts and checked experience, arrived at through human ingenuity, under conditions of relative freedom of the individual scientist. That does not apply to those who travel the international road to distant lands with commercial interests, conflicting national aims, or fossilized political theory.

Despite some acquaintance with history and considerable experience in peace and war in many lands, I may be off the beam when I say that modern industry itself is at times a potent cause of war. Such industries, developed in locations or in nations where raw materials must be secured from other lands, the products of the industry disposed of largely in other lands, and with a population in excess of the food resources of the country, obviously render the people in those countries dependent on peaceful cooperation or war with other nations. When competing industries develop in other lands, conflicts are inevitable, both as to the raw materials and as to fields of trade. Political and industrial diplomats usually camouflage these conflicts with more altruistic and palatable connotations. We now discern such conflicts in new regions as a consequence of the recent elimination of Germany and Japan from the industrial scene.

In addition to building springboards for war, modern industry, by literally turning the earth inside out at a rate to which living forms have never before been exposed, has created other hazards to man's health and welfare. The atomic bomb is the culmination, not the initiation, of these new and man-made enemies. Given facilities and freedom, medical and engineering science of tomorrow may master this most recent enemy of man.

If there be a third world war, bigger and better atomic bombs will wreck and retard our industrial civilization. But such a war will not obliterate our species; and, lest current fears make us forget, many civilizations of the past have decayed and disappeared without the aid of the weapons of modern warfare. Slavery, parasitism, chicks that chirp but do not scratch, are potent enemies of our race. War, violence, and atomic bombs are on the screen for the moment, but these are but some of our many enemies.

In the past, we in the natural sciences have regarded it as self-evident and obvious that discoveries in science are not for personal or national gain. Such discoveries are for the increased understanding and aid of mankind. Is this principle, is this philosophy, wrong? Is the black-out of this principle by war necessary? And if necessary in actual war, is the black-out necessary for individual national security for an indefinite period during peace? I raise the question because it is one now pending, particularly in our own country, and because it has significant meaning for the entire human race. If the principle of the black-out in science shall prevail in war and in peace, science becomes not an instrument of understanding but an instrument of additional suspicion and fear.

Our Association embraces all science, all American scientists, and not a few scientists in other lands and climes. No one scientist can speak for all men of science, but you are in a position properly to value, if not condone, my insistence that next to man himself—that is, man's unchecked greed, vanity, and fear—disease is man's major enemy, at least until depletion of national resources for industry and insufficient foods loom larger on the distant horizon. As a biologist I deplore the diversion of tens of thousands of competent scientists and such large fortunes in human toil, past, present, and future, to devising better ways to kill and injure our fellow men, better ways to waste and destroy our natural resources by war, because the frontiers of biology and medicine are still so vast. We have scarcely made a dent in the matter of prevention of the hereditary defects of man, of cancer or virus diseases, of the preventable impairments of the aging citizen. It seems stupid to pause to kill and maim our fellow men when there remains so much worthwhile work to do toward developing a healthier, wiser, and happier man of tomorrow.

Unless guile is coequal with integrity in man's survival and progress, it seems obvious that integrity, cooperation, and approximate justice constitute the very warp and woof of the "standard" to which all wise and honest men must repair. We certainly get nowhere with guile in the understanding and control of inanimate nature or in the understanding and control of heredity, health, and disease in living nature. We can, for a time, guide human action by guile and force. Some day our colleagues in the social sciences, by the methods and ethics known to work in the natural sciences, will provide man with data on human behavior which are as reliable and as unavoidable as are the confirmed data of chemistry and physics of today. When that day is here, guile and guess in human relations will surely recede, assuming that man of that era retains present mental capacities.

Science Legislation

On the Floor of the Senate

Howard A. Meyerhoff
Executive Secretary, AAAS, Washington, D. C.

On 19 March the Senate Committee on Military Affairs considered the Kilgore-Magnuson Bill, S. 1850, creating a National Science Foundation, and reported it out of committee. S. 1850 is now on the floor of the Senate.

It has taken seven months to compose a bill that meets the requirements of scientists, government agencies, and the small group of Senators actively interested in science legislation, and to get this bill through committee. Comparable delays in the Senate and in the House can be fatal, for a third of our Senators, and all of our Representatives, are understandably concerned with election problems back home. Congress is not going to remain in session any longer than it must. It certainly will not linger for the purpose of creating a National Science Foundation unless Congressmen know that some of the influential people in their respective districts believe that this is important and enlightened legislation, which should have their support in the present Congress and not a promise of support in the next session.

On 16 March Senator Thomas of Utah, chairman of the Committee on Military Affairs, addressed a meeting at which 19 of Philadelphia's scientific organizations were represented. Senator Thomas, who is a member of the AAAS, devoted most of his time to a discussion of the significance of S. 1850 when he talked to the representatives of these organizations. Rather pessimistically, he pointed out the preoccupation of Congressmen with problems of re-election and ventured the prediction that S. 1850 can die in the Senate, and will almost surely die in the House—unless scientists show much greater interest than they have up to the present time.

Senator Thomas is so impressed with the wisdom of this bill that he pledged himself to reintroduce it in the next session, if it failed of passage this year. But failure this year means serious delay. It means that the teams of scientists who were at work during the war will become even more dispersed, more difficult to reassemble to pursue the research tasks of peace. Although scientists will appreciate the wholehearted support of Senator Thomas, it was clear from his remarks that they must assume a great deal of the responsibility for the ultimate passage of the bill, and practically all of the responsibility for its passage in this session.

Report on Science Legislation

Physical Society of Pittsburgh

(1) *National Science Foundation.* We believe that there should be created an authority (National Science Foundation), hereinafter called the Organization, whose duty it would be to promote the fundamental and basic sciences in the interest of adequate national defense, of improved public health, of more effective use of our natural resources, and the increase of our scientific and industrial productivity in both quality and quantity.

(2) *Utilization of Existing Scientific Associations.* We believe that the Organization should make full use of the many recognized scientific, technical, and engineering associations that have come into existence in this country during the past decades because we feel that the membership of those groups includes the more active and capable of our scientific and technical people.

(3) *Duty of the Organization.* We believe that the primary duty of the Organization should be to foster the development of the so-called natural sciences, that is, physics, chemistry, mathematics, medicine, and biology, to name a few.

We recognize the fact that a number of eminent people believe that the scope of a National Science Foundation should include not only the "natural sciences" but also the "social sciences," such as psychology, economics, sociology, political science, anthropology, and history, for example. However, we believe that the objectives and technics of research and development in the social sciences are so different from those customary in the natural sciences that investigations in the former field should be supported by a separate authority set up for the purpose and which would be coordinate in every way with the Organization herein proposed. However, in the event that a separate authority is not feasible, we strongly recommend that the support of social science research should be included among the duties of the Organization coordinate with that of the major divisions of the natural sciences.

(4) *Liaison Between Physical and Social Sciences.* We believe that an important function of the Organization should be the development of an effective liaison between those interested primarily in the natural sciences and those working in the social sciences.

(5) *Patent Policy.* We believe that the legislation covering the establishment of the proposed Organization should not attempt to change the present basic patent policy of the Government.

(6) *Selection of Governing Board.* We believe that it is of the utmost importance to have the Organization administered by men of the highest competence, completely independent of the influence of any special group. Although several types of organization could be set up to achieve this objective, it is our opinion that the work of the Organization should be administered by a Governing Board appointed by the President from a panel of scientific people recommended through existing scientific associations and that the Director of the Organization should be chosen by the Board and be responsible to it.

(7) *Compensation and Term of Office of Board Members.* We believe that the work of the Board would be of such magnitude, importance, and complexity that the members should give it their full time and should be paid accordingly. It is our opinion that the Board should be a continuing Board and that the normal term of office of individual members should be not less than six years. The Governing Board should be authorized to enlist the aid of qualified scientific advisers and be responsible for their remuneration.

(8) *Administration of Funds.* We believe that the Board should be entrusted with the administration of all funds appropriated to the Organization and with the award of contracts for research work, development work, purchase of equipment, modification of existing facilities or creation of new, and for such other purposes as might be necessary to the prosecution of investigations sponsored by the Organization in either nonprofit or industrial organizations.

(9) *Selection of Scientific Personnel and Projects.* We believe that the Organization should assist in the discovery and training of men and women possessing unusual abilities together with the special aptitudes necessary to creative scientific work in the fields of natural science research, and that to these

Many learned societies which customarily have not concerned themselves **with public affairs as distinguished from subject-matter studies have, in recent months, put time and energy into planning solutions of public problems of interest to scientists. This event alone is characteristic of our time and, as such, deserves notice in these columns. The views of every group taking concerted action cannot be mentioned here—but the official report of the Physical Society of Pittsburgh, one of the oldest physics groups of the country, accepted at its 200th meeting a short time ago might serve as a model to others whether they agree with the details or not.**

ends the Board should be empowered to award scholarships to selected students and grants-in-aid to individual science workers. We feel that the selection of scientific personnel and projects will tax the skill and vision of even the ablest Board and that on the wisdom of their choices will depend the long-range success of the proposed effort to improve the scientific stature of our nation.

(10) *Collaboration With Government Representatives.* We believe that government representatives, Naval, Military, and others, should cooperate with the Board in advisory capacities only; that it should be the policy of the Board to seek the advice of, and to collaborate with, such representatives; that there should be no ex-officio members on the Board and that no Board member should hold any other government or private position either elective or appointive.

(11) *Publication Policy.* We believe that the Board should be responsible for publication of technical reports covering the results of researches under its sponsorship either in existing scientific and technical journals, in a publication of its own, or both. The Board should also be responsible for special publications designed to assist both the public and the Government to understand and apply effectively such developments in the fundamental or basic sciences as may arise from researches supported by the Organization.

(12) Finally, we believe that the powers vested in the Organization as well as its basic policies should be such as to assist the normal scientific activities of either individuals or organizations. We wish strongly to emphasize our conviction that the proposed Organization could best serve the nation by assisting in the creation of an environment favorable to independent thought and creative activity in the fields of both fundamental science and basic technological development, and by aiding the body politic to assimilate and benefit from the results of scientific achievements, whatever their origin.

Obituary

Theodore Crété Burnett

1861-1945

Theodore Crété Burnett, associate professor of physiology, emeritus, of the University of California, died in Oakland on 18 December 1945, twelve days after his eighty-fourth birthday.

He was born in Brooklyn, New York, on 6 December 1861, of a family which had settled in Long Island in 1643. After private preparation he entered the College of Physicians and Surgeons of Columbia University and obtained his M.D. in 1887. He practiced medicine for a few years, but contracted tuberculosis and came to California to spend what his doctors had told him would be the last six months of his life. He began to recuperate and while in Mt. Shasta City met, during the summer holidays, J. B. MacCallum, the enthusiastic assistant of Jacques Loeb. Loeb had just been called to the University of California to head the Department of Physiology with the express purpose of organizing and directing research. Dr. Burnett offered his services as assistant without salary in the fall of 1903, and so began his association with the University of California. After Loeb's withdrawal in 1910, Dr. Burnett was placed on the staff as instructor and remained a teaching member of the faculty even after his retirement as associate professor in 1929, since he continued generously and voluntarily to assist in laboratory sections where help was needed until about 1935. He eventually made his home in Carmel, California. As he approached his eightieth year, his health began to fail, and he was virtually confined to his bed for the past three years.

Dr. Burnett's early scientific work shows the influence of Loeb. His first paper (1906) was entitled "The influence of temperature on striped muscle, and its relation to chemical reaction velocity," and his second (1907) attempted to answer the question: "Can sea water maintain the beat of the heart of fresh water animals?" For the next fifteen years one or more publications bearing his name appeared each year. About 1913 he became interested in the effect on cancer of such substances as lecithin, cholesterol, and extracts of the pituitary, much of the work being done in collaboration with T. B. Robertson. Experiments on liver catalase, begun in 1918, led finally to publication of work on the use of liver extracts in the treatment of hypertension in 1929. His last paper, which appeared the following year, was on the absorption of pituitrin by the stomach.

The passing of Dr. T. C. Burnett breaks the last direct link connecting the present generation of physiologists in the University of California with the period when Jacques Loeb gave such impetus here to original investigation.

J. M. D. OLMSTED
University of California, Berkeley

Technical Papers

A New Steric Effect in Organic Chemistry[1]

HERBERT C. BROWN

Department of Chemistry, Wayne University

Current theories of organic chemistry, particularly those developed by the English school (*5*), have emphasized the polar factor of substituents to the almost complete neglect of their steric factor. That is to say, these theories have sought to explain the effect of a given substituent by considering only the effect of that substituent upon the charge distribution within the molecule, without also considering the role played by the steric requirements of the substituent in altering the properties of the molecule.

In part, this overemphasis of the polar factor is to be ascribed to the disrepute into which the classical concept of steric hindrance had fallen as a result of its indiscriminate use by early organic theorists. These theorists found in steric hindrance a convenient explanation of phenomena which they could not readily interpret in terms of existing theory. Since these phenomena were drawn largely from the complex, little understood field of reaction rates, it is not surprising that a number of the phenomena so explained have since found other interpretations. It is unfortunate, however, that such errors led to the wide-scale abandonment of the concept and to its consequent neglect in modern theory.

Several years ago the author and his students embarked upon a program of study of relatively simple equilibria, the dissociation of molecular addition compounds, in the hope that these studies would yield unambiguous evidence upon which the concepts of steric hindrance and steric strain[2] might be firmly founded. The results already obtained offer strong support for the idea that atoms or groups of atoms through their steric requirements can exert marked effects upon molecular properties.

For example, if only the polar factor of alkyl groups were considered, it would be predicted that the strength of aliphatic amines should increase regularly with the number of alkyl groups: $NH_3 < RNH_2 < R_2NH < R_3N$ (Curve A, Fig. 1). However, the order actually observed is $NH_3 < R_3N < RNH_2 < R_2NH$ (Curve B, Fig. 1). (This discrepancy is discussed below.) In the absence of pronounced steric effects, the relative stabilities of the addition compounds formed by these amines with any given trialkylboron should exhibit the same order. This is true because the relative "strength" of the base (1) and the relative "stability" of the addition compound (2) can both be correlated with the relative tendency of the nitrogen atom in the amines to share its free electron pair.

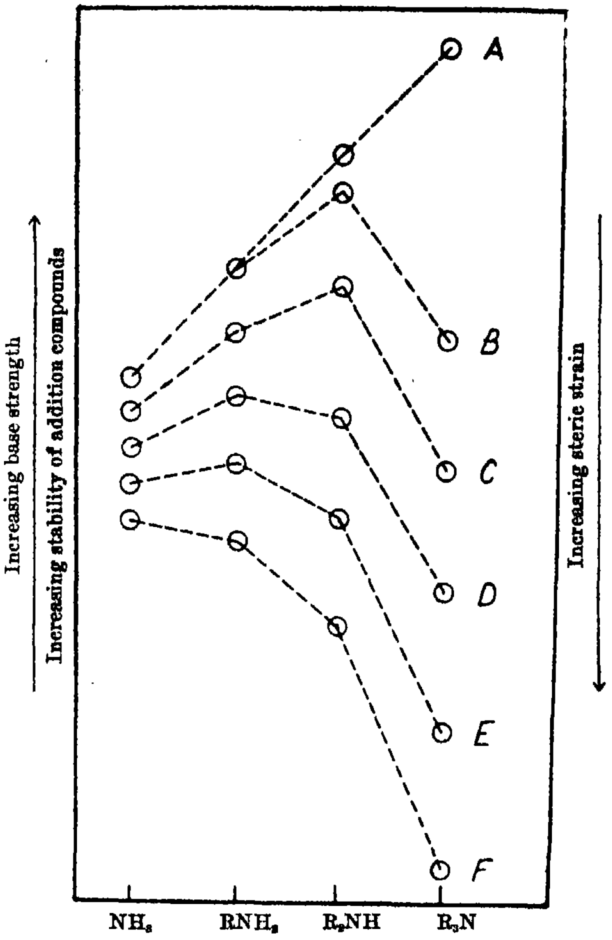


FIG. 1. Sequences shown by the aliphatic amines in comparisons of their base strengths and of the stabilities of their addition compounds with trialkylborons.

$$\begin{matrix} (1) & R_3N:H^+ & = & R_3N: & + & H^+ \\ (2) & R_3N:BR'_3 & = & R_3N: & + & BR'_3 \end{matrix}$$

However, it has been possible to cause the observed order to vary from B to D, to E, and to F merely by increasing the size of the alkyl groups attached either to the nitrogen atom of the amine or to the boron atom of the other component of the addition compound (Fig. 1; Table 1) (*2*).

---

[1] This research program at Wayne University on the effects of steric strains has been made possible by Grants No. 710 and 776 from the Penrose Fund of the American Philosophical Society. This assistance is gratefully acknowledged.

[2] The term "steric hindrance" is to be associated with a temporary condition in a reacting system; "steric strain," with an equilibrium condition in a relatively permanent system.

TABLE 1

SEQUENCES SHOWN BY AMINE SERIES WITH VARIOUS REFERENCE ACIDS

Amine series	Reference acid		
	H^+	$(CH_3)_3B$	$(t\text{-}C_4H_9)_3B$
Methyl	B	B	E
Ethyl	B	D	F
Isopropyl ...	B	E	
t-Butyl		F	

The relative tendency of these addition compounds to dissociate can be varied in a definite and predictable manner by varying the size and bulk of the alkyl substituents. It is therefore reasonable to conclude that the observed changes in the relative stabilities of these compounds must have a steric origin. More precisely, it is reasonable to attribute the increased dissociation to steric interference between the bulky alkyl groups attached to the nitrogen atom and those attached to the boron atom. Such interference would result in a strain at the "interface" between the two components, a strain which would tend to separate them. This "frontal" strain, in many respects similar to the classical concept of steric hindrance, has been termed F-strain to differentiate it from B-strain, which has no counterpart in classical theory (*3*).

B-strain was originally introduced to explain the anomalous weakness of tertiary amines (compare theoretical Curve A with observed Curve B, Fig. 1). It was suggested that, in such amines, the steric requirements of the three alkyl groups crowded about the small nitrogen atom are met by a spreading of the C-N-C bond angle from the 90° value predicted by quantum theory to a value somewhat greater than that of the tetrahedral angle. Such expansion of the bond angle is facilitated by the absence of a fourth group on the nitrogen atom. Addition of a proton (or other group) to the free electron pair tends to reduce the expanded angles to the tetrahedral value. This results in increased crowding of the three alkyl groups and the introduction of considerable strain into the molecule. This strain (called B-strain since it is localized at the "back" of the amine molecule) causes the amine to resist the addition of the proton (or other group) and leads to an apparent weakening of the strength of the base.

The hypothesis is strongly supported by observations on the behavior of phosphine and the methylphosphines. The greatly increased size of the central atom should result in the absence of B-strain. Experiment reveals that the base strength of these compounds increases regularly with the number of methyl groups, $PH_3 < CH_3PH_2 < (CH_3)_2PH < (CH_3)_3P$ (Curve A, Fig. 1) (*1*). The B-strain hypothesis offers a reasonable, simple explanation for this marked difference in the behavior of the phosphorus and nitrogen bases.

If three alkyl groups about a nitrogen atom bring about a condition of strain, it follows from the close similarity in the dimensions of the two atoms that three such groups about a carbon atom should also be a center of strain. This postulate offers a reasonable explanation of many hitherto unrelated peculiarities of branched-chain carbon compounds. A few of these may be briefly described.

(1) *Molecular rearrangements.* Alcohols with the structure R_2CHCH_2OH and R_3CCH_2OH exhibit a marked tendency to undergo rearrangement in reactions involving removal or replacement of the hydroxyl group (*6*). In such rearrangements either a hydrogen atom or an alkyl group attached to the tertiary or quaternary carbon atom migrates. The marked lability of such groups is easily explicable in terms of the strain postulated by the B-strain hypothesis at such carbon atoms.

(2) *Hydrolysis of alkyl halides.* Ingold, Hughes, and their co-workers have demonstrated conclusively that tertiary halides hydrolyze by a mechanism involving ionization of the halides as the rate-determining step (*4*). They have ascribed the greatly increased tendency of the tertiary halides to undergo such ionization to the cumulative inductive effect of the three alkyl groups attached to the carbon atom which holds the halogen. We wish to suggest that B-strain in the halide also facilitates the ionization, since such strain should be relieved by the expansion of the bond angles to 120° in the presumably planar carbonium ion.

$$R_3CCl \quad = \quad R_3C^+ \quad + \quad Cl^-$$

Indeed, a study of the effect of the size of the alkyl groups in such tertiary halides upon the rates of hydrolysis (recently completed at this university) has yielded results which would be exceedingly difficult to interpret without the aid of the B-strain concept.

(3) *Behavior of tertiary alcohols.* The unique properties of tertiary alcohols have never received an adequate explanation. According to the B-strain hypothesis, the strain resulting from the presence of the three alkyl groups furnishes a potent driving force to convert such alcohols to the relatively strain-free carbonium ions. Thus, reactions which involve carbonium-ion intermediates are greatly facilitated. Since the strain would also be relieved by the formation of the olefins, the marked tendency for such

compounds to undergo dehydration is also in accord with the hypothesis.

(*4*) *Selective dehydration of alcohols.* Dehydration of alcohols, such as $R_2CHCHOHCH_2R$, involving the possibility of loss of either an adjacent tertiary or an adjacent secondary hydrogen atom invariably proceeds by the first-mentioned path. Again, this is readily explicable in terms of the B-strain hypothesis.

Recent work has shown that the presence of two very bulky groups attached to a single atom may be the center of marked B-strain. The instability of such compounds as di-*t*-butylether and di-*t*-butylamine is ascribed to this cause. A quantitative estimate of the B-strain in such compounds has recently been made. Its magnitude, 5 to 7 kcal, is such as readily to account for the behavior of such substances.

It is believed that the B-strain hypothesis shows promise of being a fruitful unifying concept in organic chemistry. Experimental tests of the hypothesis are being prosecuted as vigorously as present conditions permit. It is hoped that these investigations will assist in drawing the attention of organic chemists to the desirability of including in their considerations both factors, polar and steric.

References

1. BROWN, H. C. *J. Amer. chem. Soc.*, 1945, **67**, 503.
2. BROWN, H. C. *J. Amer. chem. Soc.*, 1945, **67**, 374, 378, 1452; BROWN, H. C., and PEARSALL, H. *J. Amer. chem. Soc.*, 1945, **67**, 1765.
3. BROWN, H. C., BARTHOLOMAY, H., and TAYLOR, M. D. *J. Amer. chem. Soc.*, 1944, **66**, 435.
4. HUGHES, E. D. *Trans. Faraday Soc.*, 1941, **37**, 603. (Leading references.)
5. WATSON, H. B. *Modern theories of organic chemistry.* (2nd ed.) Oxford: Oxford Univ. Press, 1941; REMICK, A. E. *Electronic interpretations of organic chemistry.* New York: Wiley, 1943.
6. WHITMORE, F. C. *J. Amer. chem. Soc.*, 1932, **54**, 3274.

The Detoxification by Acetylation of Soluble Antigens From *Shigella dysenteriae* (Shiga) and *E. typhosa*[1]

HENRY P. TREFFERS

Yale University School of Medicine

The toxicity of available vaccines against typhoid and other gram-negative organisms has long been recognized as a serious defect, particularly under military conditions where the loss in personnel time due to vaccination reactions may be significant. Attempts to provide reasonable type-specific coverage against the more important dysentery organisms with polyvalent vaccines must also take into account the additive nature of the toxicities of the component organisms. The only solution at present is to reduce the amount of each component until the toxicity of the combination is within tolerable limits. Since the antigenic efficiency of a component is influenced by its concentration, it is obvious that additional injections must be made to reach a high level of protection, a procedure which apparently produces many administrative difficulties.

Numerous attempts have been made to detoxify either the whole organisms or selected antigenic fractions, but in spite of the application of a wide variety of reactions the loss in toxicity has almost invariably been accompanied by a corresponding decrease in antigenicity (*4, 6*). An exception may be noted for the action of ketene gas (*1*) on some gram-negative organisms, but this promising reaction does not seem to have been widely applied in practice.

In our studies on the development of a practical vaccine against *Shigella dysenteriae* (Shiga), we have favored the use of a soluble antigen—the somatic polysaccharide, or polysaccharide-protein complex (*6*). Although it was recognized that this might not be the only antigen responsible for protection, it was felt that elimination of less active components of the organisms might be advantageous, particularly if the material was to be incorporated into a polyvalent vaccine with the corresponding antigens of other members of the dysentery group. In searching for a method of detoxification we have noted the preparation by several workers of acetylated derivatives of bacterial polysaccharides (*3, 5*). Although quite complete chemical characterizations have been made, little or no data on the biological properties of the fractions are available, with the exception of the observation that acetylated antigens do not react well with antisera to the whole organisms.

We have therefore prepared a series of acetylated derivatives of the polysaccharide, or the polysaccharide-protein complex, of *Shigella dysenteriae* and of *E. typhosa* (Army strain 58) and have investigated their toxicity and antigenicity. The soluble toxic antigens were dissolved in a small amount of water, diluted with several volumes of pyridine, and allowed to react at room temperature with an excess of acetic anhydride. The general technique of Freeman (*3*) was followed, with the exception that samples were removed at shorter intervals, and the reactions stopped by pouring the aliquots into water. As acetylation proceeded, an increasing percentage of the antigens became insoluble in water.

In all cases even the water-soluble fraction isolated after the minimum time allowed for acetylation (1.5 hours) showed an appreciable decrease in toxicity over that of the original material. The fractions water-insoluble after acetylation for 24 hours were the least toxic.

---

[1] Preliminary report. The work described in this paper was done with the assistance of Miss Claire B. Abrams and Mr. Ben A. Rubin, under a contract recommended by the Committee on Medical Research of the Office of Scientific Research and Development, and Yale University. The experiments were begun under a similar contract with Harvard University.

Toxicity was determined from the weight loss in mice. For a base line, six mice were given an intraperitoneal injection of 0.5 ml. of saline, which was the solvent or vehicle used for the other antigens, and the mouse weights determined daily. Other groups, of as near the same age and weight as possible, were given 0.5 ml. of antigen solution or suspension and the weights estimated in terms of percentage loss or gain from the control group. Four mice given 0.4 mg. of undetoxified Shiga soluble antigen all died; with 0.2 mg. ¾ died; with 0.1 mg. no deaths occurred, but there was a drop in weight which reached 13 per cent by the third day; with 0.05 mg. there was only a 6-per cent weight loss for three days.

At a greatly increased dosage (3.0 mg.) the 12 acetylated derivatives prepared from this antigen did not kill any of the 48 mice used. The weight losses of the injected mice varied from a maximum of 10 per cent for the less acetylated soluble fractions to zero for most of the water-insoluble fractions or more highly acetylated soluble fractions. By this method, then, the toxicity of many of the fractions was at least 60 times less than that of the original material.

Preliminary results with a small group of rabbits, which are especially sensitive to these toxins, indicate that a single injection of 0.005 mg. of the undetoxified Shiga antigen will produce a temperature rise of 2.7° C., with a characteristic initial leucopenia followed by a leucocytosis. On repeated injection, temperature rises as high as 3.6° C. have been obtained, with a leucocytosis of 36,000 after 18 hours. A sixty-fold larger dose (0.3 mg.) of the acetylated antigens produced responses which, for the less highly acetylated soluble antigens, were about equal to those given by 0.005 mg. of the toxic material, while the responses for the insoluble fractions were more moderate (temperature rises of 1.6° C., leucocyte counts of 12,000). The detoxification ratio of 60 or more for the most highly acetylated fractions was thus confirmed in these animals. It is possible that at least a part of the toxicity remaining in the soluble, less highly acetylated fractions is due to contamination with traces of the starting material, from which it is difficult to separate. The insoluble antigens, on the other hand, could be repeatedly washed free of soluble substances.

On intraperitoneal or subcutaneous injection into mice none of the acetylated fractions has yielded agglutinins for intact Shiga organisms, although these are readily produced by injection of the unacetylated, toxic complex. On first sight the fractions were thought not to be antigenic or, if so, of a specificity markedly different from that of the unacetylated material. That the latter is the case is indicated by the fact that more extensive immunization of rabbits has given rise to antibody which precipitates with acetylated fractions, although it does not agglutinate the intact organisms.

Of greater interest is the observation that mice given three subcutaneous or intraperitoneal injections of 0.05 mg. of the acetylated fractions do show active protection against infection with live Shiga organisms administered intracerebrally by Dubos' method (*2*). The data for three independent series of experiments are summarized in Table 1.

TABLE 1

SURVIVAL RATES OF IMMUNIZED MICE AFTER INTRACEREBRAL CHALLENGE WITH LIVE SHIGA DYSENTERY ORGANISMS

Immunizing antigen, given in 3 doses of 0.05 mg. each	Survivals	
	Number	Per cent
None—controls	4/55	7
Unacetylated, toxic Shiga antigen ...	4/15	27
Shiga antigens acetylated 1.5–4 hr. ..	19/93	20
Shiga antigens acetylated 5–24 hr. ..	64/151	42

It may be noted that the figures tabulated are for pools of animals; in some groups immunized with a particular fraction the survival rate was somewhat better (5/8), but the data for the smaller numbers of animals are not as significant statistically as are those for the combined groups. In a single experiment in which the challenge dose was administered intraperitoneally with mucin, 29 of the 61 mice (48 per cent) survived, as compared with none of 16 controls.

It should also be noted from Table 1 that the protection afforded appears to increase with acetylation, from which it may be concluded that the observed protection is not due to contamination of the acetylated antigens with small amounts of unchanged starting material. The protection in terms of multiples of MLD's is not impressive when compared to those of typhoid or Flexner dysentery protection experiments, but it is not out of line with that obtained typically in experimental Shiga infections.

Preliminary experiments with the protein-polysaccharide complex of *E. typhosa* indicate that significant detoxification of that antigen also may be obtained on acetylation. In a toxicity titration of the original soluble antigen in mice, the LD_{50} lay between 0.3 mg. (1/5 deaths, with 12 per cent weight loss) and 0.6 mg. (8/11 deaths). However, none of the 18 mice injected with 5.0 mg. of the acetylated fractions died, although some fractions produced transient weight losses of 10–15 per cent. The order of detoxification is thus about the same as for the Shiga antigen. The protective power against active infection with typhoid organisms is now under investigation.

References

1. Boyd, M. J., and Tamura, J. T. *Science*, 1936, **83**, 61; U. S. Pat. 2,224,591.
2. Dubos, R. J., Strauss, J. H., and Pierce, C. *J. exp. Med.*, 1943, **78**, 161.
3. Freeman, G. G. *Biochem. J.*, 1942, **36**, 340.
4. Goebel, W. F., Binkley, F., and Perlman, E. *J. exp. Med.*, 1945, **81**, 315, 331.
5. Heidelberger, M., Kendall, F. E., and Scherp, H. W. *J. exp. Med.*, 1936, **64**, 559.
6. Morgan, W. T. J., and Partridge, S. M. *Biochem. J.*, 1940, **34**, 169.

On the Blocking Antibody and the Zone Phenomenon in Human Anti-Rh Sera

Philip Levine and R. K. Waller
Ortho Research Foundation, Linden, New Jersey

Recent findings by Race (*7*), Wiener (*8*), and Diamond (*2*) indicate the importance of the indirect test as evidence of active isoimmunization in Rh– mothers of erythroblastotic infants. According to Levine (*6*), only 50 per cent of Rh– mothers who recently delivered infants suffering from this hemolytic disease have active anti-Rh agglutinins in their sera. In the remaining sera which fail to agglutinate Rh– blood, antibodies are present which specifically coat the surface of Rh+ red cells, rendering them resistant to the action of potent anti-Rh agglutinins. Diamond and Abelson (*3*) found that these so-called "incomplete," "blocking," or "inhibiting" antibodies will agglutinate heavy suspensions of fresh blood in tests carried out on slides. Presumably, the determining factor is the use of serum instead of saline as the medium for the cell suspension (*9*).

These significant findings on the behavior of blocking antibodies were confirmed. However, Diamond's observation that blocking sera will agglutinate heavy suspensions of washed blood could not be repeated. In order to facilitate studies on the specificity of the agglutination reactions given by blocking antibodies, Diamond's method was modified by the use of a 2-per cent cell suspension in human serum and test tubes instead of slides.

In the course of these confirmatory tests additional observations were made on the properties of those anti-Rh sera which exhibit the so-called zone phenomenon. Obviously, these sera contain both anti-Rh agglutinins and blocking antibodies, but the concentration of the former is greater. By and large, such sera were not considered as useful diagnostic reagents unless the agglutinin in a particular serum was far more active than the blocking antibody. However, the experiments presented indicate that at least some of these sera can be absorbed with Rh+ blood, so that after the blocking antibody is specifically removed the treated serum becomes a useful diagnostic reagent.[1] A typical experiment, given in Table 1, was carried out with the same serum originally described as exhibiting the zone phenomenon.[2]

TABLE 1

	Serum Sil.* Diluted 1:									
	2	4	8	16	32	64	128	256	512	1,024
Untreated	tr	±	+	+	++±	++	++±	+	±	0
Absorbed at 37° C.	+++	+++	+++	+++±	+++±	++±	+	±	0	0
Absorbed at 0° C.	+++	+++	+++±	++	++±	++±	+	+	±	0

* The serum of patient Sil. was drawn in July 1942, and tests indicated in the table were carried out in July 1945. The undiluted serum was absorbed with an equal volume of washed sediment of Rh+ blood at both 37° C. and 0° C., but the agglutinin activity of the absorbed and unabsorbed sera were tested at 37° C. with 2-per cent saline suspension of Rh+ blood.

The test shows a somewhat higher titer with the serum absorbed at the lower temperature. Presumably, a slight quantity of the agglutinating activity was absorbed at 37° C., along with all of the blocking antibody.

Similar results were obtained with two other anti-Rh sera, one of which gave only doubtful reactions in the course of the titration. On absorption at 0° the two sera had agglutination titers of 1:32 and 1:16, respectively. The corresponding titers, after absorption at 37° C., were 1:2 and 1:4.

As was to be expected, the absorption mixtures with undiluted serum exhibited no gross agglutination; this was a favorable circumstance, because unagglutinated cells present a much larger surface area for specific absorption than agglutinated cells. This view could be confirmed in parallel absorption tests of pure anti-Rh agglutinins which require several treatments for complete absorption, whereas blocking antibodies of identical degree of activity were almost completely removed by one absorption.

The result presented in Table 1 could be duplicated in tests with a mixture consisting of equal parts of an anti-Rh_0 serum with agglutinating activity and another serum containing only blocking antibodies. On absorption of this mixture, which simulates to a remarkable degree the so-called zone phenomenon, it was possible to recover a great deal of the agglutinating activity (Table 2).

---

[1] After these experiments were completed, reference was found to similar absorption tests carried out by Wiener (*8*), but there is no indication that he tested the activity of the residual agglutinins by titration.

[2] The serum used in this test did not exhibit the zone phenomenon when first studied in July 1942. On standing for several months in the ice chest the serum was no longer found to be useful for routine testing because it exhibited the zone phenomenon to a striking degree (*5*).

The results indicate a slight, but distinct, zone effect in the mixture absorbed at 0° C. To a more striking degree the same effect was observed in mixtures of the same blocking serum with each of two other potent anti-Rh$_0$ agglutinins. This effect is probably due to incomplete absorption of the blocking antibodies in the mixture at the lower temperature. On absorption at 37° C., the blocking antibody was removed completely, but at the same time, there was a slight, but definite, loss of agglutinin titer. Nevertheless, the treated serum is still useful as a diagnostic reagent.

TABLE 2*

Serum	Diluted 1 : 2	4	8	16	32	64	128	256	512	1,024
1	+++	+++	+++	++±	++	++	+±	+	tr	0
2	0	0	0	0	±	+	++	++±	+++	+++
1 + 2, aa	0	0	0	ftr	±	+	+	±	ftr	0
1 + 2, absorbed at 37° C.	+++	+++	+++	+	±	tr	0	0	0	0
1 + 2, absorbed at 0° C.	+	+±	++	+++	++	+	±	0	0	0

* Absorption of mixture of Sera 1 and 2 with equal volume of washed sediment of Rh+ blood. The titrations were tested with a 2-per cent saline suspension of Rh+ blood. Serum 1 is a pure agglutinating serum (anti-Rh$_0$). Serum 2 is a "pure" blocking serum. The readings given for Serum 2 were made after the addition of a 1 : 10 dilution of a potent anti-Rh$_0$ serum. The result indicates a blocking antibody titer of 1 : 64–1 : 128.

Anti-Rh sera exhibiting the zone phenomenon behave somewhat differently in specific absorption at 37° and at 0° C. If the absorption of the blocking antibody is complete at the lower temperature, the treated serum is apt to give higher agglutinin titer than that shown by the serum absorbed at 37° C. On absorption at the higher temperature, the blocking antibody is removed first, and if this absorption is complete, some of the agglutinin activity may also be lost. Accordingly, one can expect to find for each serum a dosage of the absorbing blood which, under certain conditions, will remove all of the blocking antibody without influencing the agglutinin titer to any great extent.

Without carrying out absorption tests, it is difficult to state how often anti-Rh sera contain both blocking antibodies and agglutinins. The authors studied several sera with such concentration of the two antibodies that, even on titration, only traces of direct agglutination could be observed. Unless these tests are read microscopically, the weak degrees of agglutination in the higher dilutions could readily be overlooked. Furthermore, it seems probable that routine titration tests will entirely fail to detect those sera containing weak agglutinins and strong blocking antibodies. These views could be substantiated in experiments on mixtures of an agglutinating serum and an excess of a blocking serum. Although no zone effect could be obtained on titration, absorption of the undiluted mixture with Rh+ blood yielded a fluid which had strong agglutinating activity.

It is significant that in the observations reported, the tests were carried out with diluted cell suspensions in saline. Under these conditions, specific absorption of certain anti-Rh sera reveal the presence of agglutinins even in the presence of strong blocking antibodies.

These findings have some bearing on the nature of the agglutinating activity of blocking sera, and the available evidence indicates that this agglutination is a manifestation of the blocking antibody per se. This could be determined in a few instances by titration results of blocking sera diluted in normal human serum instead of saline. These tests were carried out not only on slides with heavy suspensions of unwashed blood, but also in test tubes with 2-per cent cell suspensions in serum. The results with the latter modification provide proof that the slide agglutination does not depend upon the use of a "large number of red cells to absorb the inhibiting substances (blocking antibody) and to combine with agglutinin in sufficient number to form easily visible clumps" (*3*). As first suggested by Wiener, the essential mechanism in the slide test as direct evidence of blocking activity is the use of serum as the medium for suspending the Rh+ red cells. In further support of this view is our failure to obtain a positive slide test with the use of washed blood.

In contrast to the observations on the slide test is the finding that the agglutinin in a particular anti-Rh serum masked by an excess of blocking antibody can be studied quantitatively by the usual procedures after specific absorption of the blocking antibody.

From a practical standpoint, the significance of these findings lies in the fact that the characteristics of the agglutinating antibody and the blocking antibody are sufficiently clear-cut so that, for example, there is no difficulty in the use of an anti-Rh serum which contains an anti-Rh′ agglutinin and also an anti-Rh$_0$ blocking antibody.

Addendum: After this paper was submitted (August 1945), several important studies on the characteristics of blocking antibodies have appeared (*1, 4, 10*). The use of the term "conglutination" suggested by Wiener for the test with serum-suspended cells was criticized by Coombs, Mourant, and Race. One of the objections is based upon the presence of a heat-labile "conglutinating" complement.

References

1. Coombs, R. R. A., Mourant, A. E., and Race, R. R. *Brit. J. exp. Path.*, 1945, **26**, 255.
2. Diamond, L. K., and Abelson, N. M. *J. clin. Invest.*, 1945, **24**, 122.
3. Diamond, L. K., and Abelson, N. M. *J. lab. clin. Med.*, 1945, **30**, 204.
4. Diamond, L. K., and Denton, R. L. *J. lab. clin. Med.*, 1945, **30**, 821.
5. Levine, P. *Arch. Path.*, 1944, **37**, 83.
6. Levine, P., Burnham, L., Katzin, E., and Vogel, P. *Amer. J. Obstet. Gynec.*, 1941, **42**, 925.
7. Race, R. R. *Nature, Lond.*, 1944, **153**, 771.
8. Wiener, A. S. *Proc. Soc. exp. Biol. Med.*, 1944, **56**, 173.
9. Wiener, A. S. *Proc. N. Y. Acad. Sci.*, 18 May 1945.
10. Wiener, A. S. *J. lab. clin. Med.*, 1945, **30**, 662.

Relapses Following Delayed Treatment of Naturally Induced *Vivax* Malaria of Pacific Origin

Harry H. Gordon, Lt. Col., M.C.; Alexander Marble, Col., M.C.; William W. Engstrom, Capt., M.C.; Henry A. Brunsting, Capt., M.C.; and Stuart W. Lippincott, Lt. Col., M.C.

Army Service Forces, Eighth Service Command
Harmon General Hospital, Longview, Texas

A most difficult problem in the treatment of *vivax* malaria of South and Southwest Pacific origin is the stubborn tendency of the disease to relapse. The exact mechanism of relapse is not known (*9*), but the suggestion has been made that drug therapy which promptly and completely aborts the primary clinical attack may inhibit the development of acquired immunity (*8*). This, in turn, may be partially responsible for the relapse (*9*). Accordingly, it seemed reasonable to consider that prompt therapy of acute attacks such as soldiers obtain might be responsible for the large number of relapses, and to suggest the desirability of investigating the effect of withholding treatment if an opportunity arose (*6*). The establishment by the Surgeon General of a center for the treatment of neurosyphilis at an Army hospital, to which large numbers of soldiers with relapsing *vivax* malaria had been admitted, has given an opportunity to study various facets of the primary attack of malaria. This report presents data on the effect of delay of institution of quinacrine therapy on the tendency to relapse.

Ten white soldiers with malaria, acquired in the South or Southwest Pacific, volunteered as the original sources for the infection of the American anopheline mosquitoes (*10*) used for natural induction of the disease in 69 white soldiers who required malaria therapy because of neurosyphilis. The administration of quinacrine dihydrochloride (2.8 grams in 6 days) was delayed until the patients had had from 8 to 15 paroxysms with an average of approximately 40 hours of fever over 104° F. This level was reached on the average in approximately 20 days, during which blood smears were positive for malaria parasites. The patients were then followed either until a relapse occurred or for at least 60 days without a relapse. Thick smears of the blood were examined twice weekly for parasites during the period of observation, except during an interval of three weeks of furlough immediately after completion of quinacrine therapy. None of the patients received antiluetic therapy with heavy metals during the period of observation for relapse.

It is seen in Table 1 that 45 patients (65 per cent) have had a relapse. There were no significant differences between the mean hours of fever above 104° or between the mean days of parasitemia in those patients who relapsed and those who did not. Of 16 patients observed following quinacrine therapy of the first relapse, 11 (69 per cent) have had a second relapse. In a group of 124 patients who contracted *vivax* malaria in the same overseas areas and whose relapses at Harmon General Hospital were treated promptly with quinacrine, 92 (74 per cent) relapsed. Relapse rates of 70, 76, and 77 per cent following prompt treatment of initial attacks have been reported by Dieuaide (*3*) for three organizations serving overseas. The differences between the rates of relapse following prompt and delayed treatment can hardly be considered of practical significance. Such a result was to be expected from the findings of Boyd and Kitchen (*1*) that there was no relationship between the duration of illness prior to therapeutic termination of the primary attack and the rate of relapse.

TABLE 1

Relapses Following Quinacrine Treatment of *Vivax* Malaria of South or Southwest Pacific Origin

	Delayed treatment of first attack of mosquito-induced therapeutic malaria	Prompt treatment of relapses of naturally acquired malaria
No. of cases	69	124
No. of relapses	45*	92†
Per cent relapse	65	74

	Relapses		Relapses	
Time to relapse in days‡	Number	Per cent (Cumulative)	Number	Per cent (Cumulative)
Less than 29	2	4	6	7
30– 59	32	76	45	55
60– 89	8	93	21	78
90–119	2	98	12	91
120–149	0	..	8	95
150–179	0	..	5	100
188	1	100	..	...
Total	45	100	92	100

* Average period of observation of nonrelapsers in days: 109 (range, 66–185).

† Average period of observation of nonrelapsers in days: 148 (range, 62–353).

‡ Calculated from time of completion of treatment.

Seventy-six per cent of the relapses which developed within the period of observation following delayed treatment of the patients with mosquito-induced therapeutic malaria occurred within 59 days, and 93 per cent within 89 days following completion of quinacrine treatment. In the patients with naturally acquired malaria, 55 per cent of the observed relapses occurred within 59 days and 78 per cent within 89 days. This apparently longer period to relapse in the group with the naturally acquired disease may be due to the fact that the latter patients had had an average of eight relapses before inclusion in the study. For 9 of the 11 patients with induced malaria who had a second relapse following prompt treatment of the first relapse, the interval to the second relapse was from 6 to 52 days longer than the interval from treatment of the primary attack to the first relapse. For 1 patient, the interval was only 2 days longer, and for 1 patient 11 days shorter. The interval between first and second relapses averaged 22 days more than the interval between the primary attack and the first relapse for these 11 patients.

Relapses occurred in men infected with 7 of the 10 "strains" used. With 3 of the strains no relapses occurred, but only 7 men had been infected by these strains. Thirty-three of the neurosyphilitic soldiers were infected with the "Chesson strain" (Ehrman, *et al.*, *10*), and 25 (76 per cent) had relapses. Although these strains yielded so many relapses after induction of the disease by the bites of mosquitoes, it is noteworthy that in 28 men inoculated intravenously with 5 to 7 cc. of blood containing trophozoites of the same strains of malaria, none have relapsed during a period of observation averaging 106 days and ranging from 66 to 165 days. The importance of the route of inoculation in deciding whether the disease produced is of a relapsing type has previously been noted by James (*5*), and its relation to the production of exoerythrocytic schizonts has been discussed by Porter and Huff (*7*). Evidence that the source of the malaria is also important in determining the rates of relapse (*4*) is suggested by the fact that in 16 soldiers in whom *vivax* malaria of Mediterranean origin was induced by mosquito bites, only 2 (13 per cent) have relapsed to date. These relapses occurred at 111 and 189 days after completion of quinacrine therapy. The period of observation of the 14 patients who did not relapse ranged from 61 to 162 and averaged 113 days.

Although prolonged activity of the infection undoubtedly influences mechanisms of both cellular and humoral immunity (*2*), there is no evidence in this study to support the suggestion that early treatment may delay the development of "immunity" to malaria as measured solely by the incidence of initial relapses. A further delay in administration of quinacrine, perhaps until spontaneous remission, may be associated with a lower rate of relapse. Such rigorous management does not, however, seem justified, since the natural course of the disease is toward eventual cure even with prompt therapy of acute attacks (*3*).

References

1. Boyd, M. F., and Kitchen, S. F. *Amer. J. trop. Med.*, 1944, **24**, 221.
2. Coggeshall, L. T. *Medicine*, 1943, **22**, 87.
3. Dieuaide, F. R. *War Med.*, 1945, **7**, 7.
4. Grimán, Q. M. *New Eng. J. Med.*, 1943, **229**, 293, 324.
5. James, S. P. *Trans. Roy. Soc. trop. Med. Hyg.*, 1931, **24**, 477.
6. Morgan, H. J., and Dieuaide, F. R. *Trans. Ass. Amer. Physicians*, 1944, **58**, 53.
7. Porter, R. J., and Huff, C. G. *Amer. J. trop. Med.*, 1940, **20**, 869.
8. Sinton, J. A. *J. mal. Inst. India*, 1939, **2**, 191 (quoted by Taliaferro, *9*).
9. Taliaferro, W. H. *Amer. J. clin. Path.*, 1944, **14**, 593.
10. Young, M. D., Stubbs, T. H., Moore, J. A., Ehrman, F. C., Hardman, N. F., Ellis, J. M., and Burgess, R. W. *J. nat. mal. Soc.*, 1945, **4**, 127; Ehrman, F. C., Ellis, J. M., and Young, M. D. *Science*, 1945, **101**, 377.

U. S. News and Notes

Dr. Joseph Hughes will succeed the late Dr. Harold D. Palmer as professor of psychiatry at the Woman's Medical College of Pennsylvania. Since 1943 Dr. Hughes has served with the U. S. Navy. At present he holds the rank of Commander and is chief of the neuropsychiatric service at the Philadelphia Naval Hospital.

Frederick L. Knowles, senior biophysicist, National Institute of Health, has been named editor of the *Journal of the National Malaria Society*, succeeding Dr. R. B. Watson, formerly with the Tennessee Valley Authority, who has joined the staff of the International Health Division of the Rockefeller Foundation. The *Journal* is a quarterly devoted exclusively to malaria and its associated problems. Subscriptions are $3.00 per year and may be obtained through Dr. Martin D. Young, P. O. Box 1344, Columbia, South Carolina.

Dr. Frithjof Setter, until recently immunologist and biochemist in the Michigan State Department of Health Laboratories, has joined the Technical Staff of Parke, Davis and Company, Detroit, as assistant to the director of the Biological Manufacturing Department.

Dr. Samuel L. Meyer, assistant professor of botany at the University of Tennessee, has been appointed associate professor of biology at Emory University, Georgia. Dr. Meyer has recently been discharged from the Army.

Dr. H. M. Weaver, senior administrative assistant and assistant professor of anatomy, Wayne University College of Medicine, Detroit, has been named assistant to the medical director of the National Foundation for Infantile Paralysis.

Dr. G. D. Shallenberger, professor of physics, and chairman of the department, has returned to Montana State University after seven months service with the Army Educational Program in Europe. He served at Shrivenham, in Marseilles, and in Frankfort.

President Karl T. Compton, of Massachusetts Institute of Technology, was awarded an honorary degree in engineering from Worcester Polytechnic Institute, where he delivered the Seventy-seventh Annual Commencement Address on 23 February.

Dr. Albert C. Spaulding has been appointed assistant curator in charge of the anthropological collections at the Museum of Natural History of the University of Kansas, with the additional title of instructor in anthropology. Dr. Spaulding has had three years in the Government services.

Dr. Roy L. Whistler has resigned as chief of the Starch Structure Section at the Northern Regional Laboratory and has joined the Purdue staff as assistant professor of agricultural chemistry. He will continue research on the chemistry of carbohydrates.

Dr. F. H. Winslow, formerly associated with the Manhattan District Project, and R. D. Heidenreich, formerly of the Dow Chemical Company, have become members of the technical staff of the Chemical Laboratories of Bell Telephone Laboratories, Murray Hill, New Jersey.

Announcements

The Du Pont Company has announced plans to award more than twice as many university fellowships this year as in 1945. The chemical industry today is facing a serious shortage of chemists, physicists, and engineers with advanced training. To help meet this problem the Du Pont plan provides for 41 postgraduate fellowships in chemistry, 5 in physics, 15 in chemical engineering, and 7 in mechanical engineering. Six postdoctoral fellowships in chemistry also are included in the enlarged fellowship program. Each postgraduate fellowship provides $1,200 for a single person or $1,800 for a married person, together with an award of $1,000 to the university. Each postdoctoral fellowship carries a stipend of $3,000, with an award of $1,500 to the university. The award of the $1,000 to the university in connection with the postgraduate fellowship and the $1,500 which accompanies the postdoctoral fellowship are intended to finance tuition and fees. The remainder of each fund is to be turned over to the department administering the fellowship for whatever purpose may seem desirable.

A New Department of Social Relations under the Faculty of Arts and Sciences has been established at Harvard University. This department will incorporate all of the present Department of Sociology, that part of the Department of Psychology which has dealt primarily with social and clinical psychology, and that part of the Department of Anthropology concerned primarily with social anthropology. The new department is empowered to offer an undergraduate program of concentration in social relations, and graduate programs leading to the M.A. and Ph.D. degrees in sociology, social anthropology, social psychology, and clinical psychology. Instruction will begin in the Summer Term of 1946.

The personnel of the new department will include, from among the present Harvard staff, Talcott Parsons, professor of sociology and chairman of the department; G. W. Allport, professor of psychology; P. A. Sorokin, professor of sociology; C. C. Zimmerman, associate professor of sociology; Clyde Kluckhohn, associate professor of anthropology; George C. Homans, associate professor of sociology; Robert W. White, lecturer in psychology and director of the Psychological Clinic; Stanley G. Estes, Thelma G. Alper, and Jerome S. Bruner, lecturers in psychology; Oscar Handlin, faculty instructor in social science; and James G. Miller, faculty instructor in psychology.

In addition, Samuel A. Stouffer, formerly professor of sociology at the University of Chicago and director of research in the Education and Information Division of the War Department, has been appointed professor of sociology and will join the department in September 1946.

A Psychology Section has been instituted by Dr. R. M. Page in the Fire, Missile and Pilotless Aircraft Control Division of the Naval Research Laboratory, Office of Research and Inventions, Washington, D. C. The Section, which will conduct psychological research on problems related to the design and operation of missile control equipment and on the training of the operators of these devices, includes: Dr. Franklin V. Taylor, formerly assistant professor of psychology, Princeton University; Dr. Alston S. Householder, formerly assistant professor of biophysics, University of Chicago; Dr. Robert Y. Walker, formerly director of the Institute of Aviation Psychology, University of Tennessee; and Dr. Lloyd V. Searle, formerly assistant director of a wartime project of the National Defense Research Committee, Fort Bragg.

Applications for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the Committee, Prof. Frederick G. Keyes, Massachusetts Institute of Technology, Cambridge 39, Massachusetts, not later than 15 April 1946. Grants are made in aid of chemical research, generally for apparatus or supplies, or for the construction of special facilities needed for research in chemistry or in fields closely related to chemistry. Grants are not awarded for salaries, and on account of limited resources, the amount to an individual is seldom in excess of $300. Application blanks may be obtained from the chairman upon request.

The American Society of Plastic and Reconstructive Surgery announces the publication of an official periodical to be known as *Plastic and Reconstructive Surgery*. The first number will appear in July, and the journal will be issued bimonthly. One volume of 500 pages will be issued each year, and the subscription price will be $6.00. Dr. Warren B. Davis, of Philadelphia, the editor, will have the assistance of a board of 12 associate editors. Subscriptions should be sent to the publishers, The Williams and Wilkins Company, Baltimore 2, Maryland.

Meetings

The Pennsylvania Academy of Science will hold its annual meeting Easter weekend, 19 and 20 April 1946, at Lehigh University, Bethlehem, Pennsylvania. Dr. Bradford Willard, of the Geology Department, Lehigh University, is president of the organization. The Academy was organized in 1925 and has a membership of over 600, most of whom are Pennsylvania scientists. The Pennsylvania Junior Academy of Science will resume its statewide meetings at the same time and place.

The Aero Medical Association of the United States will meet for its seventeenth annual convention at the Edgewater Beach Hotel, Chicago, on 7–9 April 1946.

The American Geophysical Union will hold its Twenty-seventh Annual Meeting in the Hall of Government, George Washington University, Washington, D. C., on 27–29 May. Information concerning the program may be secured from the office of the American Geophysical Union, 5241 Broad Branch Road, N. W., Washington 15, D. C.

Twenty-seven civilian and military electroencephalographers from several different states met at the Graduate Club of the Institute of Living at Hartford, Connecticut, on 1 March to organize the Eastern Association of Electroencephalographers. Formed for the purpose of promoting research in the field, the Association plans to pool scientific information concerning the neurophysiology and clinical application of electroencephalography.

Lt. Cdr. Robert S. Schwab, MC, USN, of the U. S. Naval Hospital in Boston, was elected chairman of the Association, and Dr. Charles W. Stephenson, of Hartford, was elected recorder.

One of the immediate projects of the group is to approach the American Physiological Society, the American Neurological Society, the American Psychiatric Association, and the Council of Physical Medicine of the American Medical Association, on the matter of establishing a joint committee among the several organizations for the purpose of considering the desirability and means of establishing minimum standards for approved electroencephalographic laboratories. Chairman of the committee appointed to pursue this project is Dr. Hallowell Davis, associate professor of physiology at Harvard; members are Dr. Paul A. Hoefer, associate professor of neurology at Columbia University, and Dr. Margaret Kennard, assistant professor of neuropsychiatry and neuroanatomy at New York University.

Elections

The Torrey Botanical Club announces the following officers for 1946: Dr. P. W. Zimmerman, Boyce Thompson Institute for Plant Research, president; Dr. John A. Small, New Jersey College for Women, 1st vice-president; Dr. Henry K. Svenson, Brooklyn Botanic Garden, 2nd vice-president; Dr. Jennie L. S. Simpson, Hunter College, corresponding secretary; Mr. Libero Ajello, Columbia University, recording secretary; Dr. Edmund H. Fulling, New York Botanical Garden, treasurer; Dr. Harold W. Rickett, New York Botanical Garden, editor; Mrs. Lazella Schwarten, Arnold Arboretum, bibliographer; and Dr. Anne M. Hanson, Columbia University, business manager.

Dr. Howard A. Robinson, chief physicist of the Armstrong Cork Company, was recently elected chairman of the Executive Committee of the Division of High-Polymer Physics of The American Physical Society.

International News

Dr. F. J. Belinfante, of the University of Leiden, has been appointed associate professor in theoretical physics at the University of British Columbia, Vancouver. He will assume his duties in September 1946.

Dr. A. Velel Taning writes from Copenhagen how greatly he appreciates the re-establishment of communication with other countries ". . . because I much enjoy reading articles and books from abroad after these many dark years, during which all connection with the civilized world was totally cut off. . . . We succeeded here in keeping the Dana Collections intact during the war and we have published some papers of the Dana Reports, which will be forwarded to the several institutions in the near future. Very much material from the Dana Expeditions has been arranged for distribution to our collaborators abroad and papers from them are now coming in for printing. This is a pleasure after these years lost."

Gunnar von Bahr, assistant professor at Upsala University, Sweden, has received a Government grant to study eye surgery in the United States.

Prof. J. P. Wibaut, of the University of Amsterdam, Holland, has written to M. T. Bogert, president of the International Union of Chemistry, as follows: "We have had very hard and difficult years, but we are thankful now to the gallant Allied Forces for our liberation. As long as it was possible there has been done much work in my laboratory."

Prof. J. Orcel, curator of mineralogy of the Museum National d'Histoire Naturelle at Paris, has written to Prof. Charles H. Behre, Jr., that his laboratories did not suffer materially from the occupation or from the war, though research of all sorts was—and still is, to some degree—greatly curtailed.

Dr. Antoine Ball, curator of insects in the Musée Royal d'Histoire Naturelle de Belgique, Brussels, wrote to Dr. P. P. Calvert on 7 December 1945, acknowledging receipt of publications sent and adding: "We have had a miserable time over here, but personally I am thankful to be able to say that none of my near relatives lost their lives on account of the war. The Museum sustained no damage."

The Moscow News of 12 December 1945 reports the death of Prof. Vladimir Leontyevich Komarov, president of the Academy of Sciences of the USSR and dean of Russian botanists, in Moscow in December. He was best known for his work on the flora of Kamchatka and as editor-in-chief of the *Flora* of the USSR, started in 1934, of which 10 volumes have been published to date.

Dr. Otto Rosenheim, London, in writing to Mr. Marvin H. Hack, University of Illinois, College of Medicine, says:

> There seems to be an air of mystery about the fate and whereabouts of German scientists of the prewar period. I have not heard anything about Klenk, who came to see me about ten years ago, when I presented him with some of Thudichum's preparations. Dr. Girard, of Paris, whom I met recently, informed me that Butenandt (Berlin) is working at present in Tubingen, in the French Zone of Occupation, and that Warbourg is back in Berlin after having fled to his villa in the island of Rugen. Wieland is supposed to be in Starnberg, near Munich, where his laboratory has been completely destroyed.

Prof. P. E. Verkade, Technische Hoogeschool, Delft, has written to Dr. Austin M. Patterson, Antioch College, that he has survived the war and his present address is 's-Gravenhage, Waalsdorperweg 88. He is chairman of the International Committee on Organic Chemical Nomenclature of the International Union of Chemistry, of which Dr. Patterson is the American member.

Dr. E. Leloup, Musée Royal d'Histoire Naturelle de Belgique, Brussels, has written to Dr. E. S. Deevey, Jr., Woods Hole, Oceanographic Institute, that he has been able to continue his work on hydroids during the war and he also said that Prof. A. Billard, the French student of hydroids, died two or three years ago of pneumonia.

Dr. Ing. Boh. Ma Mařan, director of the Institute for Forest Research, Prague XIX, Na Cvičišti 2, Czechoslovakia, writes to Dr. H. A. Lunt, of the Connecticut Agricultural Experiment Station, that he has had no contact with scientists in this country for the past seven years and is very eager for bulletins, reprints, and reports of progress pertaining to forest research, including forest soils.

Dr. Quido Zaruba-Pfefferman has written to Prof. Charles H. Behre, Jr., from Prague that many colleagues in geology are no longer alive. Among the deceased are Prof. Francizec Ulrich, Dr. R. Novacek, and Prof. Rosicky, executed in the concentration camp at Mauthausen. However, Prof. Slavik, the oldest professor of the Karlova University, Prague, returned safely after three years in the Buchenwald concentration camp. Prof. Kettner, who was in the United States at the time of the 1934 International Geological Congress, survived the German occupation.

Dr. Erna Mohr, curator of fishes, Hamburg Museum, has written to C. L. Hubbs, of The Scripps Institution of Oceanography, as follows:

> The sand eels for your museum have been burned, our Syngnathides, Centriscides and Echeneides too, but all the other fishes (in the Hamburg Museum) are safe. We must work hard to regain a library. In better times I must ask you to help us in this task. . . . I'm so sorry to hear that J. Norman is dead. Duncker, aged 75, is quite agile. Please give my best wishes to Herre and Myers!

Steps to explore the raw materials in India capable of producing atomic energy and to study methods of harnessing them were taken by the Board of Scientific and Industrial Research of the Government of India at their last meeting in New Delhi in January. The governing body of the Board set up a committee under the chairmanship of Dr. H. J. Bhabha, F.R.S., to explore the availability of raw materials in India capable of generating atomic energy, suggest ways and means of harnessing them, and keep in touch with similar organizations in other countries. The other members of the committee are Dr. Sir S. S. Bhatnagar, F.R.S., Dr. K. S. Krishnan, F.R.S., Dr. M. N. Saha, F.R.S., Dr. D. N. Wadia, Dr. Nazir Ahmed, and Dr. Jivraj Mehta. The governing body also set up a committee with Sir S. S. Bhatnagar as convener, to work out in this connection a program of research on beryllium and its master alloy.

Dr. F. P. Koumans, Leiden, has written Dr. Carl L. Hubbs giving further news regarding ichthyologists and fish collections. Dr. Koumans himself has just returned to Leiden from Copenhagen, where he spent a month recovering his health.

Of the Dutch ichthyologists Prof. Beaufort, Amsterdam, Prof. Delsman, Hilversum, and Dr. Havinga are well. Dr. Redeke died in the Spring of 1945 at the age of 71. Dr. Jan Verwey, formerly of Batavia and more recently director of the Zoological Station at Den Helder, is well. The building at Den Helder was damaged, and the whole institution was evacuated in 1940 to the Leiden Museum, to return late in December 1945, after the Station was partly repaired. Dr. Koumans knows of no ichthyologist in Belgium since the death of Giltay, of Brussels, in 1937.

Very little is known of German ichthyologists or institutions, as communications are not yet re-established. The museum and library at Hamburg were ruined, but the collections partly saved. The Berlin Museum is partly ruined, and the Senckenberg Museum in Frankfurt totally destroyed. It is not known what became of the collections. Ahl, of Berlin, was said to have been wounded in the war. Kiel is so damaged that the university was brought to Flensburg.

The National Institute of Sciences of India, Bangalor, which has recently been recognized by the India Government as the primary scientific organization of the country, at their twelfth annual meeting passed a resolution favoring strict international control of atomic energy by a World Peace Organization. Following is the text of the resolution:

> Fellows of the National Institute record it as their considered opinion that any attempt to keep future atomic knowledge a secret will not only fail in view of the fact that basic atomic secrets have already been disclosed, but will lead immediately to a dangerous armament race and ultimately to war. They are of the opinion that the only security for humanity against destructive use of atomic weapons is to be found in setting up an international organization which will promote free exchange of all basic knowledge between scientists of all nations to ensure its use only for peaceful ends. The National Institute will give support to any international organization of scientists which may be formed for the purpose of bringing to the attention of all peoples and governments the necessity of placing atomic energy developments exclusively in the hands of such a world organization.

The Boca del Río Health Center and Tropical Medicine Training Station was formerly inaugurated on 21 February by the President of the Republic of Mexico, General of the Division Manuel Avila Camacho. He was accompanied by the Minister of Health and Welfare, Dr. Gustavo Baz; the Minister of Public Education, Mr. Jaime Torres Bodet; the Minister of National Economy, Ing. Gustavo Serrano; the Minister of the Navy, General Heriberto Jara; the Governor of the State of Veracruz, Mr. Adolfo Ruiz Cortines; and many officials of the federal, state, and local services.

Addresses were made by Dr. Pilar Hernández Lira, Director of the Health Center and Tropical Medicine Training Station; Dr. E. Harold Hinman, Director de Cooperación Interamericana de Salubridad Públioa and Representative of the Institute of Inter-American Affairs; and Dr. Gustavo Baz, Minister of Health and Welfare.

This training station will provide excellent opportunities for training and research in tropical medicine as well as in public health, and it is hoped that it will provide field facilities in these specialties not only for students but also investigators from Mexico and other countries in the Americas.

The Dirección de Cooperación Interamericana de Salubridad Pública, a cooperative health service established by the Secretaría de Salubridad y Asistencia of Mexico and the Institute of Inter-American Affairs, built and equipped the building.

A committee appointed by the Board of Scientific and Industrial Research, New Delhi, will undertake a systematic examination of the radioactive contents of minerals occurring in the different rock systems of India. This study is expected to be of help in understanding the chronological order of the great undated rock systems of the Deccan and the general geological layout of the Indian subcontinent. The knowledge thus gained will help mineralogists and prospectors in locating minerals and oils of economic value.

In the Laboratory

Assay of *p*-aminobenzoic Acid

DERROL PENNINGTON
University of Washington, Seattle

At the time Dr. J. C. Lewis published his microbiological assay method for *p*-aminobenzoic acid (*3*), we had developed a similar assay using a different organism.[1] Since Lewis' method seemed admirable in all respects, and ours offered no unique advantage, our results were not published. In a recent private communication, however, Lewis stated that the organism used in his test, *Lactobacillus arabinosus* 17-5, could be trained to give relatively stable *p*-aminobenzoic acid nonrequiring lines by subculturing in the presence of suboptimal levels of *p*-aminobenzoic acid. He also reported that recently his stock culture gained the ability to dispense with *p*-aminobenzoic acid after maintaining a stable requirement for at least three years. The factors responsible for such changes have not been elucidated. In view of this and since other available methods (*1, 2, 4*) suffer either in convenience or sensitivity, it appears worth while to record that another organism, *Leuconostoc mesenterioides* Pd-60, is suitable for *p*-aminobenzoic acid assay.

In general, the basal medium and technique of Lewis' assay can be used with *Leuc. mesenterioides*, with the following differences noted. The assay tubes should be incubated at 37° C. for 15 hours. One-tenth millimicrogram of *p*-aminobenzoic acid per milliliter of medium gives maximum growth. The extent of growth must be determined turbidimetrically (*5*), since the organism does not produce large amounts of lactic acid. Samples of various natural products assayed with both organisms give comparable results. Representative values are given in Table 1.

The samples assayed were prepared by autoclaving 1-gram samples of the substance with 5 ml. of six normal sulfuric acids at 15 pounds pressure for 15 minutes. The samples were then neutralized with barium hydroxide, diluted to an appropriate volume, and filtered. Very little destruction of pure *p*-aminobenzoic acid was caused by this procedure, and maximum values were obtained in tissue extracts. Hot-water extraction or enzyme hydrolysis made available only a fraction of the total vitamin in the samples. Contrary to the findings of Lampen and Peterson (*1*), alkaline hydrolysis caused almost total destruction of the activity of tissue extracts, although the pure vitamin itself was not appreciably affected by that treatment. Tissue extracts were found to deteriorate rapidly on standing, even when kept frozen, and were therefore assayed on the day prepared.

TABLE 1

Sample	*Leuconostoc mesenterioides*	*Lactobacillus arabinosis*
	micrograms per gram	*micrograms per gram*
Yeast	4.9	5.5
Wheat germ	1.7	1.7
Whole wheat	0.49	0.63
Egg	0.31	0.25
Banana	0.46	0.48
Peanuts, raw	1.6	1.7
Spinach	1.0	1.3
Beef liver	1.5	1.1
Beef muscle	0.04	0.05
Pork chop	0.34	0.26
Blood, human	0.03	0.04
Milk	0.05	0.03
Carrots	0.2	0.1
Potato, Irish	0.4	0.5
Sweet potato	0.09	0.06

References

1. LAMPEN, J. O., and PETERSON, W. H. *J. biol. Chem.*, 1944, 153, 193.
2. LANDY, M., and DICKENS, D. M. *J. biol. Chem.*, 1942, 146, 109.
3. LEWIS, J. C. *J. biol. Chem.*, 1942, 146, 441.
4. THOMPSON, R., ISBELL, E. R., and MITCHELL, H. K. *J. biol. Chem.*, 1943, 148, 281.
5. WILLIAMS, R. J., MCALISTER, E. D., and ROEHM, R. R. *J. biol. Chem.*, 1929, 83, 815.

---

[1] This work was done by the author while holding a postdoctorate fellowship from Swift and Company in the laboratory of Prof. Roger J. Williams, at the Biochemical Institute, University of Texas, in 1942. The author wishes to acknowledge the assistance of Miss Adele Neely in carrying out the assays.

Antagonism of Salicylate by Pantoyltaurine

PHILIP G. STANSLY and CLARA M. ALVERSON
Chemotherapy Division, Stamford Research Laboratories, American Cyanamid Company, Stamford, Connecticut

Ivánovics observed (*2*) that the inhibition of growth of *E. coli* and *Staph. aureus* in simple media by low concentrations (M/400–M/500) of salicylic acid was "specifically antagonized" by pantothenic acid and to a lesser extent by pantolactone. He concluded that under these conditions salicylic acid prevented the *synthesis* of pantothenate by inhibiting the formation of α, γ-dihydroxy-β, β-dimethylbutyric acid (pantoic acid). In a "complete" medium (*i.e.* one containing pantothenic acid or its precursor) *E. coli* is not affected by salicylic acid.

Pantoyltaurine, on the other hand, inhibits the growth only of certain bacteria (e.g. hemolytic streptococci) which require preformed pantothenate for growth. It has been considered that pantoyltaurine and other analogues of pantothenic acid act by interfering with the *utilization* of pantothenate (*3, 4*). It was suggested to us[1] that it might be possible to inhibit bacteria such as *E. coli* in a complete medium by some combination of salicylate (to prevent synthesis of pantothenic acid) and pantoyltaurine (to prevent utilization of preformed pantothenate).

Preliminary to experiments in a complete medium we wished to observe the effect of combinations of pantoyltaurine and salicylic acid on the growth of *E. coli* in a chemically defined medium, such as MacLeod's. It was found that whereas inhibition of growth was obtained with salicylate alone (confirming Ivánovics), normal growth occurred with the combination of salicylate and pantoyltaurine. It was thus evident that pantoyltaurine, like pantolactone, antagonized the inhibitory effect of salicylic acid. Table 1 illustrates the antisalicylate effect of this compound. Other analogues tested in the same way (unpublished data) also showed an antisalicylate effect.

These findings suggested that pantoyltaurine is hydrolyzed, yielding pantoic acid which at pH 6.8 would exist as the pantoate ion (*1*). Assuming that hydrolysis of pantoyltaurine is the process involved, it may be calculated from Table 1 that hydrolysis of about 3 per cent could account for the observed effect. This figure was arrived at by considering that the "d" isomer of pantoate is the only active antagonist of salicylate and that pantoate is about nine times more active than pantolactone in antagonizing salicylate inhibition of *E. coli* (*6*). This should be considered an approximation in view of the errors involved in the type of assay illustrated in Table 1.

TABLE 1

ANTAGONISM OF SALICYLIC ACID INHIBITION OF *E. coli* BY PANTOYLTAURINE

Conc. drugs $\times 10^{-3}$M	10 mg. per cent salicylic acid plus		
	d(−) pantolactone	dl-sodium pantoyltaurine	taurine
2	+	+	−
1	+	+	−
1/2	+	+	−
1/4	+	−	−
1/8	+	−	−
1/16	+	−	−
1/32	−	−	−
1/64	−	−	−

Drugs: All drugs used were made up in distilled water, sterilized by filtration and serial, twofold dilutions aseptically made in the medium; medium: MacLeod's (*5*), 5 ml. final pH about 6.8; inoculum: 0.2 ml. of a 10^{-6} dilution of an 18-hour broth culture (MacLeod) per 5 ml. medium; incubation: 37° C.; + = growth visibly equal to controls without drugs; − denotes absence of visible growth after 24 hours. In the absence of any salicylate antagonist, 10 mg. per cent salicylic acid prevented appearance of visible growth for at least three days. In the absence of salicylate, neither pantoyltaurine, pantolactone, nor taurine caused any inhibition of growth.

An alternative explanation for the antisalicylate effect of pantoyltaurine may be that the material was contaminated with the pantolactone used in its preparation. However, quantitative investigation of pantoyltaurine antagonism of salicylate, the details of which will appear in a later publication, does not support this view. For example, according to Table 1, about 25 per cent contamination of dl-pantoyltaurine with dl-pantolactone (which is extremely unlikely) would be required to give the observed effect. Furthermore, the fact that other crystalline and highly purified analogues of pantothenic acid also antagonize salicylate inhibition (unpublished data) suggests that contamination with pantolactone could not be the only explanation.

The data in Table 1, which indicate that a solution of pantoyltaurine contains pantolactone or pantoate, suggest that this analogue (and others which show an antisalicylate effect) would be at a disadvantage in inhibiting the growth of those organisms which can utilize pantolactone or pantoate for the synthesis of pantothenic acid. The amount thus synthesized might be of such an order that the resulting ratio of analogue to pantothenate would be less than that required to prevent growth. Whether this disadvantage is actually sufficient to account entirely for the inactivity of the analogues against such organisms is not known at this time. It should be pointed out that the reduction in analogue concentration which would result from hydrolysis is negligible and would have little effect on the ratio (*4*), whereas the liberation of pantoate would have a considerable effect.

---

[1] By Dr. R. O. Roblin, Jr., of these laboratories. McIlwain (*Brit. J. exp. Path.*, 1943, **24**, 208) considered the possibility of a synergistic action of salicylate and pantoyltaurine on *P. morganii* and reported finding synergism under certain conditions. According to Ivánovics (*2*), however, salicylate does not exert a specific antipantothenate action on *P. morganii*. He found that salicylate inhibited *P. morganii* only in high concentration and that the inhibition was not antagonized by pantothenic acid. He considered the inhibition in this case to be due to the protein-denaturing properties of salicylic acid.

These observations do not detract from the possible usefulness of pantoyltaurine and other analogues of pantothenic acid against Group A streptococci and presumably other organisms which are incapable of utilizing, or cannot readily utilize, pantolactone or pantoic acid for pantothenic acid synthesis. As already indicated, reduction of analogue concentration (by hydrolysis) would be inconsequential. Furthermore, the inhibition of growth of Group A streptococci, for instance, with pantothenic acid analogues is an established fact.

SUMMARY

Like pantothenic acid, pantolactone, and the pantoate ion, pantoyltaurine and other pantothenic acid analogues of this type antagonize the inhibitory effect of salicylate on *E. coli*.

It is suggested that the active antagonist in a solution of such an analogue is pantolactone or pantoate. These (particularly the former) could conceivably be contaminants of the analogues. However, the liberation of pantoate by hydrolysis, appears to be a more likely explanation for the antisalicylate effect.

The presence of pantolactone or pantoate in a solution of pantoyltaurine and similar analogues of pantothenic acid provides a possible explanation for the ineffectiveness of these drugs in inhibiting the growth of microorganisms which can utilize pantolactone or pantoate for the synthesis of pantothenic acid.

References

1. Frost, D. V. *Ind. eng. Chem.* (Anal. ed.), 1943, **15**, 306.
2. Ivánovics, G. *Z. Physiol. Chem.*, 1942, **276**, 33.
3. McIlwain, H. *Brit. J. exp. Path.*, 1942, **23**, 95.
4. McIlwain, H. *Biochem. J.*, 1942, **36**, 417.
5. MacLeod, C. M. *J. exp. Med.*, 1940, **72**, 217.
6. Stansly, P. G., and Schlosser, M. E. *J. biol. Chem.*, 1945, **161**, 513.

Interference With the Antibacterial Action of Streptomycin by Reducing Agents[1]

Amedeo Bondi, Jr., Catherine C. Dietz, and
Earle H. Spaulding

Temple University School of Medicine, Philadelphia

The authors have repeatedly observed that the antibacterial action of streptomycin is significantly reduced by incubation in an anaerobic jar. When filter-paper discs are saturated with streptomycin and placed on the surface of infusion blood agar plates inoculated with *E. coli*, the resulting zones of inhibition on plates incubated anaerobically are much smaller than those on the comparable aerobic plates. The reduced activity of streptomycin anaerobically is not due to better growth conditions, since *E. coli* produces its maximum growth when incubated aerobically. Similar results may be obtained with staphylococci and other species of bacteria whose growth is favored by aerobic incubation.

These observations seemed to us to be significant, and further studies were carried out, the results of which suggest that they may have some bearing on the antibacterial action of streptomycin.

Method and results. Duplicate sets of infusion agar plates containing 2-fold concentrations of streptomycin were inoculated with various species of bacteria. One set of plates was incubated aerobically, the other in the anaerobic jar by the palladium-hydrogen method as modified by Spaulding and Goode (*8*). Plates were read for evidence of growth inhibition at the end of 24 and 48 hours incubation at 37° C. Table 1 shows the results of these tests.

TABLE 1

INHIBITION OF BACTERIAL GROWTH BY STREPTOMYCIN ON INFUSION AGAR

Organism	Incubation	Growth* in presence of streptomycin; units/ml. of agar							
		None	1.0	2.0	4.0	8.0	16.0	32.0	64.0
E. coli-S	aerobic	4	4	1	–	–	–	–	–
	anaerobic	3	3	3	3	3	3	–	–
E. coli-M	aerobic	4	4	2	–	–	–	–	–
	anaerobic	3	3	3	2	–	–	–	–
S. aureus-SM	aerobic	4	4	1	1	1	–	–	–
	anaerobic	4	4	3	3	2	2	–	–
S. aureus #7789	aerobic	4	1	–	–	–	–	–	–
	anaerobic	3	3	3	3	2	1	–	–
S. paratyphi B	aerobic	4	4	4	3	–	–	–	–
	anaerobic	3	3	3	3	2	2	2	1
S. typhimurium	aerobic	4	4	4	3	2	–	–	–
	anaerobic	2	2	2	2	2	2	1	–
Pneumo. Type I	aerobic	4	4	4	4	4	1	–	–
	anaerobic	4	4	4	4	2	1	–	–
Str. Hemolyticus C-203	aerobic	4	4	4	4	4	3	–	–
	anaerobic	4	4	4	4	3	1	–	–

* Readings made at end of 24 hours incubation; 48-hour readings were essentially the same.

Under anaerobic conditions the amount of streptomycin necessary to produce bacteriostasis was from 2 to 16 times greater than the comparable aerobic concentration. With one exception (*S. aureus*-SM), these results were observed only with organisms which produced their maximum growth on aerobic plates.

A similar experiment was carried out with extract agar. Although there was some evidence that the antibacterial action of streptomycin was greater on the aerobic plates, the difference was not large. It appeared that various reducing agents in the infusion medium played a role in inhibiting streptomycin anaerobically. The greater reducing power of infusion agar was evident from the observation that methylene blue in a concentration of 1:100,000 in this medium

---

[1] Streptomycin used in this study was generously supplied through the courtesy of Dr. D. F. Robertson, Merck and Company, Inc., Rahway, New Jersey.

was reduced during anaerobic incubation, while methylene blue extract agar plates similarly incubated were not reduced. The presence or absence of streptomycin had no apparent effect.

The anti-*E. coli* action of streptomycin was subsequently determined in tryptone and infusion broth containing cysteine or sodium thioglycollate (Table 2).

TABLE 2

THE EFFECT OF CYSTEINE AND THIOGLYCOLLATE ON THE ANTIBACTERIAL ACTION OF STREPTOMYCIN AGAINST *E. coli*

Inhibiting concentration of streptomycin	
Medium	Units/ml.
Tryptone*	1.0
Tryptone plus 0.1 per cent thioglycollate	2.0
Tryptone plus 0.1 per cent cysteine	64.0
Infusion†	16.0
Infusion plus 0.1 per cent thioglycollate	64.0
Infusion plus 0.1 per cent cysteine	> 128.0

* Difco tryptone 1.0 per cent.
† Veal infusion, 1.0 per cent tryptose, 0.03 per cent glucose.

Aside from the added SH compounds, infusion broth itself contains interfering substances, since 16 times as much streptomycin was necessary for bacteriostasis in the infusion control as in the tryptone control. The presence of cysteine increased the concentration required for bacteriostasis 64-fold in tryptone and at least 8-fold in infusion broth; the increase with thioglycollate was only 2- to 4-fold.

TABLE 3

EFFECT OF INORGANIC REDUCING AGENTS ON THE ANTIBACTERIAL ACTION OF STREPTOMYCIN AGAINST *E. coli*

Inhibiting concentration of streptomycin	
Reducing agent*	Units/ml.
Tryptone control	2.0
0.5 per cent sodium formate	32.0
0.05 per cent stannous chloride	32.0
0.05 per cent sodium bisulfite	32.0
0.05 per cent sodium hydrosulfite	16.0
0.5 per cent sodium thiosulfate	32.0

* Final concentration in tryptone broth.

The effect of cysteine on streptomycin could be due either to a reducing action or to some specific chemical reaction, especially with the sulfhydryl groups. The inactivation of penicillin (*2*) and other antibiotic agents (*1*) by cysteine is well known. The action of cysteine on streptomycin appears, however, to be different from that on penicillin, as was demonstrated in the recent report of Denkelwater, Cook, and Tishler (*4*), published while this manuscript was being prepared. These workers state that the inactivation of streptomycin by cysteine is reversible. Similar interference by sulfhydryl compounds with the antibacterial properties of mercurials (*6*) and quinones (*3*) has been reported.

If interference with the activity of streptomycin by sulfhydryl compounds is due to reducing powers, other reducing agents should likewise interfere with its action. Consequently, various reducing agents have been tested. Each of the substances studied definitely antagonized the antibacterial action of streptomycin against *E. coli*, as shown in Table 3. It is evident that the antibacterial action of streptomycin is greatly diminished by a variety of reducing agents other than sulfhydryl compounds.

Discussion. Reducing agents definitely antagonize the antibacterial activity of streptomycin. Further work will be required, however, to determine the true nature of this interference. Whether it is due to a lowering of oxygen tension or to some specific chemical reaction or both acting simultaneously, is still unknown. The SH compounds and the inorganic reducing agents could function in either capacity. The reduction in activity of streptomycin in the presence of glucose, as reported by Waksman and co-workers (*9*), could be attributed to the reducing action of this carbohydrate.

It is entirely possible that this phenomenon is related to the mode of action of streptomycin. This antibiotic displays its greatest activity against bacteria which grow better aerobically than anaerobically, e. g. *E. coli*, *S. aureus*, and *Myco. tuberculosis*. None of the obligate anaerobes is susceptible (*7*). The antibacterial action of streptomycin may be due to its ability to block some enzyme system, oxidative in nature, which is essential only to the growth of susceptible aerobic bacteria, an enzyme system which anaerobes do not possess. If this is true, it is possible that the antagonism by the reducing agent is a specific effect upon this streptomycin-enzyme relationship rather than a direct effect on the streptomycin itself. In fact, addition of the SH compounds and the inorganic reducing agents to a concentrated solution of streptomycin (1,000 units/ml.) does not result in material loss of activity, although Denkelwater and co-workers (*4*) recently reported that this antibiotic in a lower concentration was inactivated by cysteine.

Certain other practical implications are worthy of note. It is conceivable that in certain parts of the body where organic reducing agents are present or where a low oxygen tension exists, larger concentrations of streptomycin may be necessary to inhibit the growth of bacteria. Elias and Durso (*5*) recently reported that typhoid bacilli were isolated from stools in spite of the presence of large concentrations of streptomycin. These investigators suggested the presence in the body of a substance inhibitory to streptomycin. It remains to be seen whether these two phenomena are related.

It is evident that the choice of a medium is important in assaying streptomycin and in determining the susceptibility of bacteria to its antibacterial activity. Because of its antagonism for streptomycin, an infusion medium would be an unwise choice for this purpose. Eventually one of these reducing agents may prove helpful in testing the sterility of streptomycin solutions or in the culturing of fluids from patients under treatment. Cysteine may prove to be such an agent.

Summary. *The antibacterial activity of streptomycin* in infusion agar plate cultures of *E. coli* and other bacteria is diminished by anaerobic incubation. The bacteriostatic activity of this antibiotic for *E. coli* is reduced in the presence of cysteine, sodium thioglycollate, stannous chloride, sodium bisulfite, sodium hydrosulfite, sodium formate, and sodium thiosulfate. Cysteine was the most active of the agents tested. Further investigation is necessary to determine the nature of this interference. It is possible that this phenomenon is related to the mode of action of streptomycin.

References

1. Cavallito, C. L., and Bailey, J. H. *Science*, 1944, 100, 390.
2. Chow, B. F., and McKee, C. M. *Proc. Soc. exp. Biol. Med.*, 1945, 58, 175.
3. Colwell, C. A., and McCall, M. *Science*, 1945, 101, 592.
4. Denkelwater, R., Cook, M. A., and Tishler, M. *Science*, 1945, 102, 12.
5. Elias, W. F., and Durso, J. *Science*, 1945, 101, 589.
6. Fildes, Paul. *Brit. J. exp. Path.*, 1940, 21, 67.
7. Robinson, H. J., Smith, D. G., and Graessle, O. E. *Proc. Soc. exp. Biol. Med.*, 1944, 57, 226.
8. Spaulding, E. H., and Goode, W. *J. lab. clin. Med.*, 1939, 25, 305.
9. Waksman, S. A., Bugie, E., and Schatz, A. *Proc. staff Meet. Mayo Clinic*, 1944, 19, 537.

Water-level Regulator for a Series of High-temperature Water Baths[1]

I. I. Bezman and E. P. Barrett

Mellon Institute of Industrial Research
University of Pittsburgh

It was necessary in this laboratory to conduct a series of tests at 70° C., the nature of which required the use of water as a bath liquid. The tests were carried out in two water baths, and, as efficient covers for the baths were not feasible, the diagrammed system (Fig. 1), set up in less than an hour, served to maintain the levels in both baths to within ¼ in.

In operation, the reservoir bottle, located on a shelf above the water baths, is filled from a tap, J, by closing screw-clamps, I and I′, and opening clamp I″. After the reservoir bottle is filled, clamp I″ is closed and I and I′ are opened. Line D extends below the surface of bath B and serves as a delivery tube, while line E is the regulator and cuts off the supply of air to the reservoir, F, when it is reached by the water level in the bath. Siphon C keeps the level in bath A at the same level as that in B.

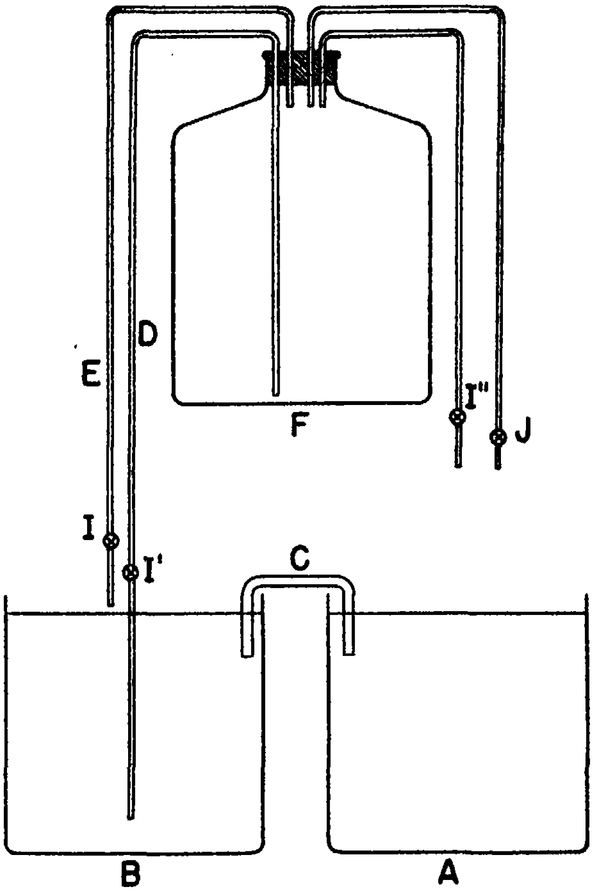


Fig. 1

The baths are of 6-gallon capacity, and the reservoir bottle holds 5 gallons. If the reservoir is filled in the late afternoon, this capacity is sufficient to make up for evaporation overnight. The tubes leading out of the reservoir are of glass, and the cork holding them is sealed in with DeKhotinsky cement. The siphon is of 15-mm. glass tubing to preclude stoppage by air bubbles.

With a sufficiently large reservoir, the system can be used to control a large number of baths. If the cost of the water is neglected, as it can be in most cases, this arrangement has a definite advantage over mineral oil baths in that cleaning of any glassware placed in the baths is much less troublesome.

---

[1] Contribution from the Industrial Fellowship on Optical Cements, Mellon Institute. Published by permission of the donor, Ordnance Department, U. S. Army.

Letters to the Editor

Soviet Scientists

The newly founded Institute of the History of Natural Sciences, USSR, has announced a publication program including such journals as *History of Russian Natural Science, Outstanding Leaders of Russian Science, Great Contributors to Russian Science.* This trend in science reporting is apparently the result of the wartime success of the Russian scientific work underlying industrialization of the USSR. Through this, the interest of the world has been awakened, not only in current Russian research, but in earlier work which was insufficiently known to contemporary scientists outside Russia at the time it was being done and has only come to be recognized in the light of recent more familiar achievements in which it culminated.

J. G. TOLPIN

Universal Oil Products Company, Chicago

Thromboplastic Studies on Hemophilia

In an article by Moldavsky, Hasselbrook, and Cateno, entitled "Penicillin effect on blood coagulation" (*Science*, 1945, 102, 38–40), the authors described some interesting findings, to wit: that after parenteral injections of penicillin in a series of patients under their care, there was noted a marked shortening in blood coagulation time after administration of that antibiotic drug. Inasmuch as we have been engaged in the study of various physical and chemical agents in respect to their thromboplastic action on the blood of both lower animals and human beings and were especially interested in the study of hemophilia, we have repeated the observations of Moldavsky, *et al.*, first on experimental animals and afterwards on hemophiliac patients. By courtesy of Dr. Howard Kern, chief of the Surgical Service, Sinai Hospital, we have confirmed Moldavsky's findings on normal-blooded clinical patients.

Employing Howell's method of studying coagulation time of whole blood, we found that injection of 2,000 to 5,000 oxford units of penicillin in medium-sized rabbits and cats produced definite shortening of coagulation time within two to three hours after administration of the drug, either by intravenous route or by intramuscular injection, thus corroborating the very valuable discovery of Moldavsky, *et al.* We have then made some studies, on two hemophiliac subjects, with intramuscular injections of penicillin. One of these subjects is a young man of 18 years, the other a man of 43 years, both of them having a normal coagulation time ranging from two to three hours.

To our great surprise we discovered that in neither subject was there noted any appreciable diminution in coagulation time after injections of quite massive doses of penicillin. One of the men received 50,000 oxford units, while the other subject was studied on two occasions, receiving 50,000 and 70,000 oxford units, respectively; in neither case was any effect produced on blood coagulation two and one-half hours after injection of the penicillin. In view of the clinical findings of Moldavsky, *et al.* on the one hand, and our own animal experiments on the other, these findings in hemophilia may be of interest in regard to its mechanism, which as yet remains an inadequately solved physiological problem.

We have, however, been much more successful in powerfully accelerating coagulation time of hemophiliac blood by means of suitable deep X-rays. The most efficient radiations in this respect were obtained by rays from 200-K.V. apparatus operating on 20 M.A. and passed through a composite filter of 2 mm. Cu at a target distance of 50 cm. Specimens of hemophiliac blood *in vitro* exposed to from 60 r to 80 r, clotted in one-half to one-third of the original time. Similar results *in vivo* were obtained in the two hemophiliacs mentioned above by giving them deep *X-ray radiations over the splenic region.* The thromboplastic effect of the irradiation persisted for as long as 10 days. A detailed report of these studies is to appear in the *Southern Medical Journal.*

Of interest also are experiments performed by us *in vitro* with certain snake venoms on hemophiliac blood. It is already known that the venom of Russell's viper (*Daboia*) hastens coagulation of such blood. We have found in addition that the venom of the South American viper (*Bothrops jararaca*) is equally efficacious in this respect. Both of these venoms *in vitro* in concentrations of 1: 100,000 to 1: 200,000 may produce a solid clot with hemophiliac blood in five minutes. Of course these venoms cannot be employed therapeutically by parenteral injection, but they may prove useful for local application.

DAVID I. MACHT, M.D., F.A.C.P., and
MARCUS OSTRO, M.D.

Departments of Pharmacology and Radiology
The Sinai Hospital, Baltimore

The Presumptive Identification of Antibiotics

In the field of antibiotics a problem exists, the solution of which would, we believe, benefit all those engaged in it. This problem concerns the presumptive identity or nonidentity of an antibiotic with one already reported in the literature.

The most satisfactory way of determining the nature of an unknown agent is to determine its physical and chemical properties and compare it with known agents. Unfortunately, for reasons well known to workers in antibiotics, it is frequently not feasible to do this. In the first place, the required data for comparison are rarely available. In the second place, the necessary purification may be extremely laborious. It is, moreover, of crucial interest to the investigator to determine the presumptive identity or nonidentity of his antibiotic *in a very early stage in the investigation.*

At the present time, the only general means available for establishing presumptive identity or nonidentity of an antibiotic with reported agents, disregarding the special cases where some unique property of an antibiotic can be utilized, is the so-called bacterial spectrum. We believe that the use of the bacterial spectrum for this purpose has a number of disadvantages: (1) It requires a considerable number of different types of organisms; (2) unless the organisms are standard, easily obtained strains, a comparison of literature values of the known antibiotics with the values for the unknown agent is subject to much uncertainty; and (3) as a result, a satisfactory comparison of the unknown antibiotic with known agents requires the test to be carried out simultaneously with the known antibiotics. The latter, however, are frequently unavailable. With these considerations in mind, the following approach is suggested as a possible solution to the problem presented.

In describing a new antibiotic, the investigator should determine, under defined conditions, the relative inhibitory effect of his antibiotic on two strains of each of two species of bacteria. One strain of each species should be the parent, susceptible to the antibiotic. The other should be a strain "made" highly resistant to the agent. The two species should preferably originate from standard bacterial strains. If possible, one species should be a representative gram-negative organism, such as *E. coli* (A.T.C.C. 9637), and the other a gram-positive organism, such as *Staph. aureus* (A.T.C.C. 6538). The four strains should then be filed with a central agency such as the American Type Culture Collection so that they would be readily available.

An investigator confronted with an antibiotic whose identity with certain reported agents is in question could then compare the relative effect of his antibiotic on the parent and the various indicated resistant strains obtained from the central agency. For example, an antibiotic is discovered which resembles subtilin in certain respects. If the unknown antibiotic is as active against a strain of *Staph. aureus* (A.T.C.C. 6538) highly resistant to subtilin as against a normal strain of *Staph. aureus* (A.T.C.C. 6538), the conclusion is justified that the two agents are not identical. In many instances, however, it would be necessary to compare the inhibition ratio of the unknown antibiotic with the published value for the known antibiotic in order to interpret the results. If necessary, the test could be extended to eliminate other reported antibiotics. Armed with this knowledge, the investigator would be in a more favorable position to report on the possible nature of his antibiotic while the investigation is still in a preliminary stage.

PHILIP G. STANSLY
American Cyanamid Company
Stamford, Connecticut

Regional Research Stations in Basic Science

The proposals for federal support of scientific research embodied in S. 1850 should have the hearty support of all scientists. Senators Kilgore and Magnuson, and their colleagues, the sponsors of these proposals for the expansion of scientific research in the United States, are to be congratulated on the able way they have developed the program. I venture to propose, however, a slight addition, which I believe will help to achieve the objectives desired.

A station for research in basic science should, in my opinion, be organized in each state and territory. These basic science research stations should be supported both by federal and by state funds. They should receive the monies apportioned to the states under the present provisions of S. 1850. In addition, each state research station should receive from the state concerned an annual amount at least equal to that received from the Federal Government.

In each state where there is a state university the state basic science research station should be associated with the state university in the same way that the state agricultural research stations are now associated with the state agricultural colleges. Each basic science research station should be under the control of the same body that administers the state university. In a state where there is *no state university* the basic science research station could be administered by a state agency established for the purpose or assigned that duty.

The scope of the basic science research stations should embrace the whole field of science. Research in the social sciences would therefore form a proper part of the program of each station.

Substations for basic research could be maintained, if desired, at research centers situated at places within a state other than at the state university. Research grants also could be made to research workers at other institutions.

These proposed basic science research stations would serve to coordinate those researches sponsored by the National Science Foundation with the researches in progress at the universities. Possible duplication of effort would thus be avoided. Such stations also would tend to prevent the possibility or suspicion that the Foundation might come to dominate too greatly the scientific research of the nation. At the same time the Foundation would serve as a coordinating agency and would act in an advisory capacity to all the state research stations.

LEE R. DICE, *Director*
Laboratory of Vertebrate Biology, University of Michigan

Science—A Means to What End?

Suddenly—the "instinct" of self-preservation has invaded the field of physics. A physicist nowadays is like a small boy who has been playing baseball in the back yard of a friend and who has knocked a home run through the big window of the living room in the house of his friend's father. His triumph at baseball is suddenly confronted with another and quite different system of values, in terms of which his triumph is no more than a misdemeanor.

In the social, unlike the physical, sciences we have always recognized more or less explicitly that science deals with means, not ends; that the ends, not the means, are the finally decisive factors; and that the ends must be conceded to depend on a system of values which cannot be determined by scientific method but which rest on the nature, and immediately on the emotional nature, of man. Among these values, these emotions, these "instincts," that of self-preservation has usually been put at the head of the list. Suddenly, after several centuries of apparent freedom from this impeding or limiting consideration, even the physicist—the most disinterested of scientists—has found that self-preservation is as intimate and inescapable a factor in his cosmogony as it is in that of the humble rodent.

Science is only a means to an end. Ah, but to what end? Is that not the first question?

C. Reinold Noyes

455 East 51st Street, New York City 22

Remarks on "Science and Man's Dilemma"

There is a point in Bruce L. Melvin's impressive article (*Science*, 1946, 103, 241–245) on which I venture to take issue with the author. He mentions *domination* as a type of social behavior, and in effect proceeds to say that war, the desire for huge fortunes, the urge to surpass others are all basic in our economic, political, and social *systems.*

It seems to me that much turns on this idea, and that the idea is erroneous. It seems to me that war, the desire for huge fortunes, the urge to surpass others are not basic in our economic system. I think that they are basic in the *practices* that prevail in the system, that these practices are essential to much of the personnel that now dominates the system and are deemed so to more of it.

I think that this personnel is fearful of its position, that it senses unworthiness in itself, and that it turns against the system antagonism that it knows should be directed against itself and its practices. Its fear is increased by knowledge that its practices are, in fact, not essential to the system, but rather are detrimental. It tries to change the public idea of our system and to change our system itself, to its own advantage.

Its fear is further increased by knowledge that its practices are not essential to the general welfare and happiness or to the development of the best that is in the world and in men. It tries to make its practices essential to the welfare of individual persons, in order to provide for the continuance of these practices. It fears practices other than its own, knowing well that these might be to the good of the system as well as to the general good. Its great ally is material want, and it seeks to maintain this or to substitute, as may be possible. It desires continuance or discontinuance of any system according to its own chances of continuing in these practices, in which it has found itself to excel.

It talks freedom, competition, patriotism, fearing them all, and it talks teamwork—hoping to continue to drive the team. It looks toward an end of these practices as toward its own doomsday, as something to be put off as far as possible, come what come may. It wants freedom from fear—for itself only—and a beggar in our country would be more sure to have it.

Carl D. Miller

327 Salem Street, North Andover, Massachusetts

Reply to Dr. Asmous on Russia

It is surprising that in 1946 a letter similar to that of Vladimir C. Asmous could appear in a scientific periodical (*Science*, 1946, 103, 281). It seems it does not contain facts but only feelings. In keeping with the tendency of the latter I should like to express the opinion, shared by many Americans, that the people whose language Dr. Asmous "does not understand" have saved his life, as well as those of 130,000,000 other citizens of this country. At least they have saved us great troubles. They did it with an unprecedented amount of sacrifice and an unparalleled development of science. And everyone, wherever he is in the world, who enjoys freedom and an opportunity to work in science, is indebted to the 20,000,000 Russians who lost their lives in defeating consciously the Nazi tyranny. Individual mistakes, failures, and tragedies are occurring everywhere and in all times. The leading article, "Science and Man's Dilemma," in the same number of *Science* contains many amiable answers to questions raised by Dr. Asmous. It is well known that the Soviet scientists and people have shown on many occasions sincere and friendly relations toward the American scientists and people. A letter like that of Dr. Asmous certainly does not contribute to the friendship of two nations.

In conclusion I should like to change the sentence of Dr. Asmous, "We are probably talking again different languages although we both were born in the same country," as follows: All three of us were born in the *same* country, talked the *same* language, and breathed the *same* air but we have *different* feelings (at least two of us). And is it not the commonest fact (often an evil) in this incoherent yet attractive promising world of the human race?

Sergei Gaposchkin

Harvard College Observatory

Rediscovery of Vitamin A

Dr. Smith's letter (*Science*, 1946, 103, 281) raises an important point, namely, the difficulty of scanning the immense literature of biochemistry well enough to know whether an observation is a new discovery. The difficulty is intensified when the early work is in Russian or Japanese, for instance, with a long interval before revival.

My own "discovery" in 1936 of the ester condition of natural vitamin A was due to unfamiliarity with the field, since I had recently emerged as a biochemist after a training in photography and high vacuum. In a later paper (*Chem. Rev.*, 1944, 34, 95, sec. II, line 1) I mention my mistake and give credit to the earlier discoverers of the ester story.

The moral surely is that we must all—authors, editors, and printers—be very careful, making first reports as

BAUSCH & LOMB

MEDIUM QUARTZ SPECTROGRAPH

This instrument covers a wavelength range of 2100 A. to 7000 A. dispersed over a length of ten inches. Because of the sharpness and cleanness of the lines provided by this spectrograph, analyses are often feasible which would ordinarily require a larger instrument. Accurate quantitative analyses of non-ferrous metals and alloys are possible. Rough estimates can be made of amounts of elements yielding spectra of moderate complexity. For complete description write for Catalog D-20. Bausch & Lomb Optical Co., 642-3 St. Paul Street, Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

accurately as possible and correcting errors as soon as discovered. With this in mind, *Science* may care to trade Messrs. Koscher and Barter for Kascher and Baxter, who were the actual authors of the article which raised Dr. Smith's ire. This will prevent a fourth (and imaginary) set of discoverers of the vitamin-A acid earth-blue color creeping into the literature.

K. HICKMAN

Distillation Products, Inc., Rochester 13, New York

[*Science* acknowledges the responsibility of introducing two fictitious investigators.]

Inactive (Non-oxygen-combining) Hemoglobin in the Blood of Ophidia and Dogs

The observations of E. Ammundsen (*Science*, 1939, **90**, 372; *J. biol. Chem.*, 1941, **138**, 563) revealed the presence of non-oxygen-combining (inactive) hemoglobin in 40 per cent of human bloods and in amounts varying from 2 to 12 per cent of total hemoglobin. Similar results were obtained by W. N. M. Ramsay (*Biochem. J.*, 1944, **38**, 470) in 17 horses, with a frequency of 82 per cent and a mean value of 8.4 per cent for inactive hemoglobin (ferrihemoglobin). In agreement with Ammundsen, Ramsay identifies the inactive hemoglobin as methemoglobin—an assertion not shared by W. S. Cox and W. B. Wendel (*J. biol. Chem.*, 1942, **143**, 331), who deny the presence of methemoglobin in the blood of various species, including man.

Since the subject is still a point of issue, it seemed worth while to extend these observations to other animal species, such as Ophidia and dogs.

In the experiments to be reported below, active Hb was determined by the oxygen capacity method of D. D. Van Slyke and W. C. Stadie (see Hawk and Bergeim's *Practical physiological chemistry.* (11th ed.) 1937); total Hb, by the iron method of E. Ponder (*J. biol. Chem.*, 1942, **144**, 333). The observed difference between active and total Hb was attributed to inactive Hb.

The following table gives the values of inactive Hb found in four species:

Author	Species	Number of animals	Number of blood samples	Inactive hemoglobin		
				Frequency %	Limits (g%)	Average (g%)
Ammundsen (1941)	Man	53	82	40	2–12	...
Ramsay (1944)	Man	38	38	55	1.5–7	3.3
Ramsay (1944)	Horse	17	17	82	3.0–25.5	8.4
Prado (1944)	Jararaca	23	23	100	6.0–28	17.0
Prado (1945)	Dog	22	31	82	3.5–20.5	10.9

The table shows the impressing fact that in *Bothrops jararaca*, frequency (100 per cent) and mean quantity (17 per cent) of inactive hemoglobin are much greater than in the other species.

This is, to our knowledge, the first observation of inactive hemoglobin in the blood of poikilothermic animals and might be of some value in the study of the physiological significance of this unusual form of hemoglobin.

J. LEAL PRADO

Instituto Butantan, São Paulo, Brasil

Book Reviews

Animal breeding plans. (3rd ed.) Jay L. Lush. Ames, Ia.: Collegiate Press, 1945. Pp. viii + 443. (Illustrated.) $3.50.

This book continues to serve as a blueprint for improvement of animals through breeding. It is conveniently organized for a logical presentation of the subject, beginning with the background of animal breeding and the genetic principles which form a basis for scientific animal breeding. Breeding plans based on selection, relationship, and somatic likeness occupy a majority of the pages. Other pertinent topics concerning breeding plans and relating to reproduction are included.

Dr. Lush has been successful in presenting the genetic bases for animal improvement in a thorough and realistic manner. Necessarily complicated genetic explanations have not been avoided or oversimplified, but have been carefully clarified. Many of the principles developed by Wright, Fisher, and others are organized and discussed in order to make them more readily available to the student, research worker, and practical animal breeder. While this book serves as a text for undergraduate courses in animal breeding, it is well adapted to the use of graduate students and research workers. For the latter groups a more complete bibliography would increase its usefulness. The references are adequate for supplemental reading and, for some chapters, are arranged under subject headings so that the reader may readily choose those which fit his particular needs.

Commercial animal breeders who have an elementary understanding of genetics will find many aids to guide them in designing a breeding program which is most efficient for their conditions. They should welcome the realistic discussion of the rate of improvement which can be expected from various breeding plans and the clear statements of what each breeding method will and will not do in changing the genetic makeup of their herds.

Only minor changes have been made from the second edition. In general these involve the addition of recent references and are adequate in bringing the book up to date in most details. No mention is made of the practice of selective registration by the Columbia Sheep Breeders Association since its organization in 1941, but this program may be too recent to permit critical evaluation. The chapter on sire indexes has been revised considerably. The book is well printed and bound. The subject index appears to be adequate.

Clair E. Terrill

USDA, Western Sheep Breeding Laboratory
Dubois, Idaho

Correlation of cycles in weather, solar activity, geomagnetic values, and planetary configurations. (1st ed.) Maxwell O. Johnson. San Francisco: Phillips and Van Orden, 1946. Pp. viii + 149. (Illustrated.)

This book consists of numerous tables and graphs of rainfall, sunspots, planetary configurations, and other data, with comments on the results. The author is convinced that various cycles of considerable lengths in years, which are related to configurations of the planets, are demonstrated. He attributes the cycles in terrestrial phenomena to cycles in solar variation, and these solar cycles to electric or magnetic influences of the planets. His object in all this extensive computation and study is to find sufficiently reliable cycles in terrestrial phenomena to be of real value in forecasting yields of crops.

My own belief in the reality of certain periodicities in solar variation inclines me to hope that predictions of value may eventually be possible from studies of them. I regret that all of Mr. Johnson's data are yearly mean values. I think that it is desirable to have a more detailed basis, using monthly values, for the solar periodicities I accept are not multiples of years.

C. G. Abbot

Smithsonian Institution, Washington, D. C.

Statistical methods: applied to experiments in agriculture and biology. George W. Snedecor. Ames, Ia. Iowa State College Press, 1946. Pp. xvi + 485. $4.50.

This is the fourth edition of this well-known work, which has been widely used in the fields of agriculture and biological research since its first appearance in 1937. The general order of presentation is the same as before: simple variation and correlation, some large sample theory and more complex cases of chi-square, analysis of variance and covariance, multiple and curvilinear regression, and more complex concepts. There has been considerable minor rearrangement, and new emphasis has been placed on sampling, fiducial limits, estimation, and components of variance. The format is somewhat more attractive than in previous editions.

The book begins with several new sections on sampling of attributes, considerably more imposing than the former very elementary opening. A table of fiducial limits for binomial material is introduced (its theory being left to Chap. 16). There is also a new and useful table of random numbers. Some of the ideas brought out in the former Chapter 1 are then developed. Other chapters show less difference from former editions, but in all there are changes. Graphic tests of significance

HELLIGE-DILLER
PHOTOELECTRIC
COLORIMETER

NEW 'Bio-PhotoCol'

CALIBRATED for 56 BIO-CHEMICAL PROCEDURES

A thoroughly developed Photoelectric Colorimeter, calibrated for 56 bio-chemical clinical procedures, more complete than any other instrument offered for this purpose.

The colorimeter is linear and has utmost differential responses which meet every requirement, electrical and engineering detail, and is unsurpassed in regard to simplicity and convenience of operation.

Six light filters of narrow spectral transmission ranges enable determinations of highest accuracy.

The colorimeter is supplied complete with all necessary accessories, including a handbook containing outlines of procedures and calibration tables for 56 bio-chemical tests and a valuable compilation of helpful and practical information concerning clinical bio-chemical methods.

Write for Bulletin No. 500

HELLIGE
INCORPORATED
3718 NORTHERN BLVD., LONG ISLAND CITY 1, N.Y.

HEADQUARTERS FOR COLORIMETRIC APPARATUS

are omitted from Chapters 2 and 4, and mathematical tests are treated more exhaustively. Fundamentals of regression and correlation are more fully discussed, and the Z-transformation is introduced. Chapter 9, on chi-square, contains some material originally in Chapter 1, as well as some new material. The chapters on analysis of variance contain material on basic assumptions, components, and disproportionate frequencies, not in older editions. Later chapters have fewer changes, but there is more attention to Gauss multipliers and more detail in discussion of single degrees of freedom, while the section on errors of "betas" is omitted. An obvious error in Example 14.7 is retained. Some familiar problems and sections are omitted and some new ones introduced.

These changes show the influence of development in the knowledge of statistics and of the work of associates on the strong staff at Ames. The book retains many of the characteristics of earlier editions. The informal language with its personal pronouns, adding to readability; the effort to develop logic "painlessly"; the presentation of tables in a form to appeal to experimenters more than to mathematicians; the strong practical emphasis and wealth of practical problems are all there. Analysis of variance is strongly emphasized, and other techniques are related to it. The close relation of the author's laboratory to experimental work in various fields is well reflected. Difficult questions are handled in an apparently easy manner, reversing the practice in some texts.

The changes superimposed on the former development have made logical outlining a little difficult. The text is definitely more valuable as a reference than earlier editions and seems more difficult to adapt to teaching. In studying and using the text, the scientific worker will feel anew the influence of the modest and unselfish work of the author and his associates, which has already contributed so much to progress.

F. M. WADLEY

Research Administration
U. S. Department of Agriculture

Organic preparations. Conrad Weygand. New York: Interscience Publishers, 1945. Pp. xiii + 534. (Illustrated.) $6.00.

This book, authorized by the Alien Property Custodian, is an English translation and condensation of *Organisch-chemische Experimentierkunst*, which was published in 1938 by J. A. Barth in Leipzig. Conversion to the English idiom is satisfactory, and indeed the publisher's Preface cites nine persons as concerned in this task.

Only the second part of the three subdivisions of the original has been translated, the other sections, concerned with materials and operations (Pt. I) and chemical analysis and physical characterization (Pt. III), having been omitted. The part translated is that entitled "Reaktionen" in the German edition. The problem of classifying organic reactions and of correlating them with laboratory practice is ever a difficult one. Prof. Weygand elected to make a classification based upon the type of bond formed. This divorces the classification from the conception of functions and their reactivity, but probably gives a more systematic treatment of collective synthetic methods. One advantage of such an arrangement is that the classification of reactions by the name of their discoverer or, as is more often the case, by that of their promoter, is distinctly subordinated. Many examples of actual laboratory procedures taken from the available voluminous literature are cited. Condensation has been effected in the translation by omitting the details but giving the references to procedures in "Organic Syntheses."

The Index, prepared by Mrs. Lucia Dawe, is greatly improved and extended from that of the German text, and the detailed Table of Contents aids in locating a particular reaction.

Apparently little effort has been made to revise the book to 1945 (excepting references to other books and to Organic Syntheses, the reviewer counted only five literature references beyond 1937), and it therefore constitutes an addition to the library of a book already available in an idiom with which an organic chemist must perforce become familiar. The book will, however, serve a useful purpose for students of organic chemistry who wish to familiarize themselves with organic synthetic methods from either a theoretical or practical standpoint. Many students will use the present translation who would veer from the German edition. The book is perhaps of more value for such a purpose than as an authoritative reference book on synthetic procedures. For example, the little section entitled "Ethers of Sugars" (pp. 165–168) is pitifully incomplete, and actually most of this small space is devoted to glycosides, which are not ethers at all, but acetals. The section on glycol-splitting reagents (pp. 454–456) is likewise inadequate from the modern standpoint.

Nevertheless, this translation will be a valued addition to our American libraries. Its appearance moves the reviewer to pose a problem. Is this book (and others like it) perhaps an intermediate phase in a future trend away from German to English supremacy in the organic monographs and texts? If so, a major task awaits the English-speaking authors, and at any event the vast accumulation of past work in German will still require familiarity with this difficult language.

M. L. WOLFROM

The Ohio State University

Scanning Science—

An Anthropological Club for informal discussion was formed in New York on March 4th. Some fifteen students of anthropology met at the house of Dr. Franz Boas and discussed the recent works on children and child psychology by Sully, Baldwin and Chamberlain, the books being reported on by Prof. Giddings, Dr. Frrand and Dr. Boas, respectively. No formal organization is proposed at this time.

—13 March 1896

SCIENCE

Vol. 103, No. 2675 Friday, April 5, 1946

The Biological Actions and Therapeutic Applications of the B-Chloroethyl Amines and Sulfides

Alfred Gilman, Major, and Frederick S. Philips, 1st Lieutenant, SnC, AUS
Pharmacology Section, Medical Division, CWS, Edgewood Arsenal, Maryland

AT THE CONCLUSION OF WORLD WAR I the theory was generally accepted that mustard gas exerted its vesicant action by releasing hydrochloric acid intracellularly. A few isolated reports appeared describing remote systemic effects of mustard gas on hematopoietic tissues (*1–3*), the gastrointestinal tract (*3–5*), and electrolyte and fluid balance (*3*). Although in the interim between wars the adverse effects of mustard gas on leucopoietic tissues (*6–8*) and on the growth of experimental tumors (*9*) received some attention, biological research on chemical warfare agents remained relatively quiescent. With the advent of World War II research on war gases was resumed, and the newer knowledge and technics of a quarter of a century of scientific progress utilized. New compounds were proposed as potential offensive agents. Mustard, *bis*(β-chloroethyl)sulfide, shared interest with a series of nitrogenous analogues, *bis*- and *tris*(β-chloroethyl)-amines. It was appreciated early that the sulfur and nitrogen mustards were not only contact vesicants but, following absorption, could exert cytotoxic actions on a variety of tissues. Furthermore, cellular susceptibility to these compounds appeared to be related in a general way to the degree of proliferative activity.

With the conviction that only with an understanding of the basic mechanisms of cellular action could significant advances be made in the treatment of vesicant war-gas casualties, the study of the actions of the sulfur and nitrogen mustards on fundamental cell processes was pursued. These studies have revealed a type of action on cells which can be likened to that of no other chemical agent but which resembles in many ways that of X-rays. Cautious preliminary trials have also been made of the possible value of the nitrogen mustards in the treatment of neoplasms, in particular those of lymphoid tissue.

The fact that agents classified as "confidential" were involved in the above studies has heretofore precluded the possibility of presenting the results in the open literature. This report reviews briefly the contributions which have focused attention on the cellular actions of the mustard compounds and gives a general description of their systemic effects as well as a preliminary statement of their possible clinical applications. Because of space limitations important contributions of many investigators will have to go unmentioned.

CHEMICAL TRANSFORMATIONS AND REACTIONS OF THE NITROGEN AND SULFUR MUSTARDS

The nitrogen and sulfur mustards owe their physiological activity to a basic chemical reaction which they share in common, namely, intramolecular cyclization in a polar solvent to form a cyclic onium cation with liberation of Cl^-. The reaction may be depicted as follows, Z representing the sulfur or nitrogen atom:

$$R{-}Z{-}CH_2CH_2Cl \rightarrow R{-}{}^{+}\overline{Z{-}CH_2CH_2} + Cl^-$$

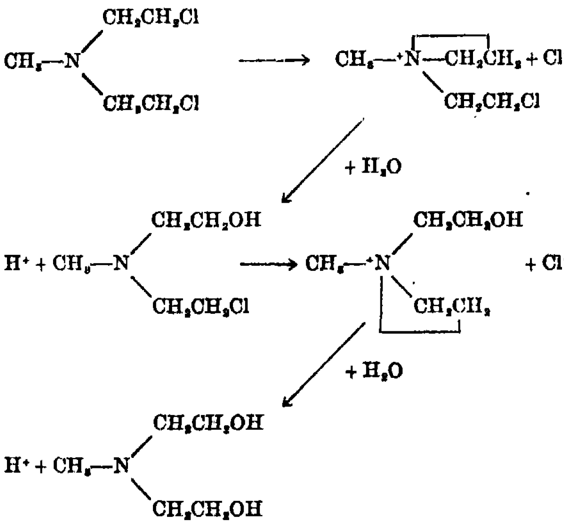
The onium cation—ethylenimonium in the case of the β-chloroethyl amines, ethylenesulfonium in the case of β-chloroethyl sulfide—reacts readily with anions and various uncharged nucleophilic molecules. It is the great reactivity of the cyclic onium cation which imparts to this group of vesicants their varied actions.

The property of halogenated alkylamines to form cyclic onium cations was known before the war (*10–12*). With the introduction of *bis*- and *tris*(β-chloro-

---

This paper was prepared as a background for forthcoming articles on the clinical application of the β-chloroethyl amines with the approval of the following agencies: Medical Division, Chemical Warfare Service, United States Army; Division 9, NDRC, and Division 5, Committee on Medical Research, OSRD; Committee on Treatment of Gas Casualties, Division of Medical Sciences, NRC; and Chemical Warfare Representative, British Commonwealth Scientific Office.

ethyl)amines as chemical warfare agents, the importance of the formation of the reactive ethylenimonium ring was appreciated early. Moreover, the study of cyclization of β-chloroethyl amines led to appreciation of the existence of the analogous sulfonium cations. The present knowledge of the chemistry of the mustards, with respect to both the kinetics of cyclization and the reactions of the resultant onium compounds, has been the cooperative contribution of many groups of investigators (*13–22*) whose final publications in the open literature must be awaited. However, so important are the basic chemical findings for an understanding and explanation of the physiological actions of the nitrogen and sulfur mustards that a few pertinent facts will be reviewed here.



$CH_3—N(CH_2CH_2Cl)_2$
$CH_3—{}^+N—CH_2CH_2 + Cl^-$
CH_2CH_2Cl
$+ H_2O$
$H^+ + CH_3—N(CH_2CH_2OH)(CH_2CH_2Cl)$
$CH_3—{}^+N(CH_2CH_2OH)(CH_2CH_2)$
$+ Cl^-$
$+ H_2O$
$H^+ + CH_3—N(CH_2CH_2OH)_2$

FIG. 1

Two basic distinctions may be made between the chemical behavior of the nitrogen and sulfur mustards. In the case of β-chloroethyl amines, cyclization cannot occur when a proton becomes coordinated with the nitrogen atom. Thus, solutions are stable in strong acid. Hydrogen-ion concentration does not affect the formation of the sulfonium ring. This distinction is of little importance at the pH of body fluids. Secondly, the reactivity of the ethylenesulfonium ring of mustard is so great that it never accumulates in solution in sufficient amount to permit its isolation. On the other hand, the various ethylenimonium compounds are, as a group, less reactive, and several have been isolated. In the case of the majority of the nitrogen mustards, this distinction is of greater chemical than physiological significance in that the reactivity of the ethylenimonium cation is ample to allow the compounds to produce toxic actions in general similar to those of sulfur mustard. For the most part, therefore, the nitrogen and sulfur mustards can be discussed together with respect to the basic relations between chemical structure and physiological actions.

As a prototype of the β-chloroethyl vesicants the behavior of methyl-*bis*(β-chloroethyl)amine may be considered. In dilute aqueous alkaline solution the series of reactions shown in Fig. 1 occurs. Side reactions involving polymerization may occur.

The majority of the nitrogen mustards are *bis*(β-chloroethyl)amines, the third valence of the nitrogen being occupied by one of a variety of alkyl groups. Inasmuch as the rate of cyclization and the activity of the ethylenimonium cation are influenced by substituent groups on the molecule, a large number of nitrogen mustards of different physicochemical and pharmacological properties is available. Thus, the scope of future investigations on the relations between chemical constitution and pharmacological action of the nitrogen mustards is wide.

In pure aqueous solutions at physiological hydrion concentrations the ethylenimonium or sulfonium cation reacts with H_2O. However, if other substances are present, they can react competitively. So reactive are some compounds that in their presence the reaction with water is negligible. Literally hundreds of compounds have been studied in this manner. The objective in many of these studies was the discovery of an effective antidote for the local and systemic actions of the mustards. More pertinent to the present discussion is the ability of ethylenesulfonium or imonium compounds to alkylate the functional groups of compounds of biological importance. Among these may be mentioned the α-amino, imidazole, sulfhydryl, sulfide, phenolic, ε-amino, and imino groups of amino acids and peptides; inorganic phosphate as well as glycerophosphate and hexose phosphates; the amino groups of adenosine and thiamine; and the pyridino-N of nicotinic acid amide and pyridoxine. The carboxyl and amino groups of numerous proteins which have been found reactive with sulfur mustard appear vulnerable to alkylation, although other functional groups are also involved. These proteins include hemoglobin, insulin, gelatin, crystalline egg albumin, tobacco mosaic virus, ovalbumin, silk fibroin, and protamine as well as various purified or crystalline enzymes to be considered below.

The implication that the systemic toxic action of the mustards is due to the reaction with any single compound listed above is not intended. However, the likelihood that the basic mechanism of the cytotoxic action of the mustards involves a similar reaction with a vital cellular constituent, possibly as yet unknown, is great.

SYSTEMIC PHARMACOLOGY AND PATHOLOGY OF THE MUSTARDS

The nitrogen and sulfur mustards elicit a variety of systemic pharmacological actions. For the most part these are prominent only after the administration of acutely lethal doses. Although the pattern of action of the compounds as a group is similar, certain distinctions are evident. Thus, the possibility exists that changes in chemical constitution can effect a specificity of action.

Cytotoxic action. The outstanding systemic action of the nitrogen and sulfur mustards is that which causes, in a manner still unexplained, the death of cells. The possible relationship between the action of the mustards on enzyme systems and their cytotoxic effects and the details of their more specific action on cell nuclei will be presented below. Pertinent to the present discussion is the relative susceptibility of the various tissues to this cytotoxic action. As a generalization, it may be stated that cellular susceptibility is related to proliferative activity. Thus the formed elements of the blood and the mucosa of the gastrointestinal tract first reflect the cytotoxic action of the mustards. The vulnerability of the blood-forming organs and the intestinal tract was realized as a result of investigations conducted during World War I, (*1–5*) and current studies on the nitrogen and sulfur mustards have contributed a wealth of new knowledge. Briefly, the action of the mustards on the blood-forming organs as reflected in the peripheral blood of both experimental animals and humans results in a lymphopenia, granulocytopenia, thrombocytopenia, and moderate anemia (*23–34*). The severity of the response is in direct relationship to the dose administered. Marked effects on hematopoiesis can be obtained with sublethal doses.

The effects of the mustards on the gastrointestinal tract are equally marked. Nausea and vomiting are evident within a few hours (*26, 35*). This may be a reflex response from the gastrointestinal mucosa or possibly the result of direct medullary stimulation. Diarrhea becomes evident within 24 hours and becomes progressively more severe. Both the vomitus and feces may contain blood. As a result of the loss of fluid and electrolyte from the gastrointestinal tract, marked changes in body water occur (*26, 35, 36*). Furthermore, there is evidence that the action of lethal doses of nitrogen mustards on the kidney may result in a polyuria and a renal wastage of extracellular electrolyte (*37*). A loss of intracellular potassium and water may also occur (*37*). Eventually, circulatory collapse ensues, a typical shock picture is observed, and the animals die of respiratory failure (*26, 35*).

Acute pharmacological actions. The acute pharmacological actions of the mustards are seen only after the administration of supralethal doses. Prominent among these are central nervous system excitation resulting in convulsions and acute death (*26, 28*), parasympathomimetic effects as evidenced by salivation, miosis, etc., followed by a parasympatholytic action (*26, 28, 38*). With subconvulsive doses of nitrogen mustard a progressive muscular paralysis, eventually resulting in death from paralysis of muscles of respiration, is a characteristic finding (*26, 28*).

Relationship between chemical constitution and pharmacodynamic action. A fact which has been pointed out by several investigators is that only those β-chloroethyl compounds which can form a cyclic onium cation are capable of exerting the typical actions described above. Moreover, the toxicity of the members of this series appears to be related to the chemical characteristics of the onium cation. Thus, the toxicity and leucotoxic activity of the nitrogen mustards and sulfur mustard have been correlated with both the reactivity of the onium cation (*26, 28*) and the rate of cyclization of the parent β-chloroethyl compound (*16*).

Pathology of systemic mustard poisoning. As might be expected from the above actions of the mustards, the outstanding pathological lesions produced by either nitrogen or sulfur mustards are found in the intestinal tract, bone marrow and lymphatic tissue (*23, 26, 27, 34*). The intestinal lesion progresses from vacuolization and nuclear swelling of the epithelial cells to eventual necrosis and desquamation with hemorrhage. Lymphoid tissue throughout the body is uniformly involved. Lymphatic fragmentation may be evident within 10 hours, leading to a persistent lymphatic atrophy for a number of days. In the bone marrow early changes include swelling and alteration in the staining reaction of hematopoietic cells and a disappearance of mitotic activity. Progressive depletion of the marrow follows, and eventually, almost complete aplasia results.

IN VITRO AND *IN VIVO* INACTIVATION OF ENZYMES BY THE MUSTARDS

The fact that the administration of the nitrogen and sulfur mustards to experimental animals results in widespread systemic intoxication naturally led to the concept that the agents inhibit certain basic metabolic functions which are vital to the maintenance of normal cellular activities. It was reasonable to expect, therefore, that a variety of cells and tissues poisoned by the mustards either *in vivo* or *in vitro* would evidence significant metabolic changes. It has, in-fact, been found that the oxygen consumption and glycolysis of a large number of cells and tissues are inhibited to varying degrees following exposure to the agents *in vitro* and in some instances *in vivo*.

One of the earliest observations which antedated the recent war showed that the addition *in vitro* of sulfur mustard to minced tumor tissue resulted in moderate reduction of oxygen consumption and marked depression of the aerobic and anaerobic glycolysis of glucose (*39*). The anaerobic glycolysis of minced brain and chick embryo tissue was similarly reduced. Similar effects were reported by English investigators to occur in mammalian skin following the application of vesicant doses of sulfur mustard (*40, 41*). It was also determined in early English work that the oxidation of pyruvate by brain brei was significantly inhibited by sulfur mustard (*42*). Later work confirmed the effects of this mustard on the oxidative and glycolytic activities of intact mammalian skin (*43*). Furthermore, the inhibition of the respiration of avian erythrocytes *in vitro* (*13*), of the respiration and anaerobic fermentation of yeast cells (*17, 44*) and of the respiration and glycolysis of isolated mammalian cornea (*45*) was also demonstrated. Following parenteral administration of lethal doses of sulfur mustard significant inhibitions of anaerobic glycolysis and respiration have been noted in bone marrow (*41*) spleen (*41, 43*), and thymus (*43*), as well as inhibition of glycogen synthesis in the liver and intestinal absorption of glucose (*43*).

Certain of the nitrogen mustards have also been shown to inhibit to varying degrees the respiration of isolated slices of such tissues as lymph node, bone marrow, spleen, brain, liver, and kidney (*43, 46*). Moreover, the utilization of pyruvate by kidney slices and the synthesis of urea by liver slices were found sensitive to nitrogen mustard *in vitro* as well as in animals which had been gassed with lethal doses (*43*).

The fact that diverse cells and tissues which had been subjected to the toxic effects of sulfur and nitrogen mustards evidenced marked metabolic defects has fostered the theory that the primary mechanism of action of the vesicants was the inactivation of essential cellular enzymes (*47, 48*). This view has been supported by extensive investigations with skin and other tissues, and in addition it has been postulated that primary inactivation occurs only in a special class of essential cellular enzymes, the phosphokinases, which are concerned with phosphate transfer to or from adenylic compounds (*41*).

The "enzyme-inactivation" theory of the mechanism of toxic action of the mustards served as the impetus for extensive investigations of the *in vitro* sensitivity of a large number of enzyme systems. Briefly, the enzymes or enzymatic systems studied included proteins containing iron, copper, and zinc, and flavin prosthetic groups; dehydrogenases; hydrolytic enzymes such as fumarase, urease, and invertase; catalysts involved in the metabolism of glucose and in reactions concerned with phosphate transfer; intracellular and extracellular proteolytic enzymes; various oxidases such as those of pyruvic acid, ascorbic acid, histamine, and choline; acetylcholine esterase, ribonuclease, hyaluronidase, and carboxylase (*13, 15, 17, 41–43, 49*). The majority of the enzymes proved only moderately sensitive or resistant to inactivation by the mustards. Among the highly sensitive enzymes were hexokinase, creatine and pyruvate phosphokinase, inorganic pyrophosphatase, adenylic acid deaminase, chick pepsin, kidney pepsinase, and peptidases of serum and skin and lung. In addition, choline oxidase, and acetylcholine esterase isolated from brain, were readily inactivated by the nitrogen mustards.

On the basis of the results obtained from studies of *in vitro* inactivation it is generally conceded that the phosphokinases as a group are highly susceptible to the mustards but share this sensitivity with other types of enzymes. In view of this finding, some doubt has been expressed concerning the possibility that the inactivation of phosphokinases *in vivo* represents the primary and specific mechanism of toxic action of the mustards, especially since no obvious correlation has been found between susceptibility of enzyme systems *in vitro* and *in vivo* (*49*).

At present it is not possible to present a final statement concerning the merits of the "enzyme-inactivation" theory of mustard intoxication. That some enzymes possess a high order of sensitivity to the agents *in vitro* cannot be questioned. Whether the inactivation of the same enzymes *in vivo* represents a primary step in the course of events leading to cell pathology is, however, open to serious question. The consensus of opinion of many investigators is that the specific chemical lesion responsible for the changes that eventually lead to cell death has not yet been defined by studies on the inactivation of enzymes. The difficulties attending the clarification of the characteristics of such a lesion are apparent in cytological studies of mammalian cornea (*45*) and yeast (*44*), where concentrations of the mustards below those which affect either respiration or glycolysis have been found to produce fundamental changes in mitotic activity.

NUCLEOTOXIC ACTION OF THE MUSTARDS

Although diverse systemic effects can be elicited in the mammalian organism by the administration of toxic amounts of the mustards, threshold doses evoke pathological changes only in cells and tissues which normally exhibit relatively high rates of prolif and growth. Considerable attention has been focused on the morphological changes exhibited by such cells in response to the mustards in the hope that such studies might provide a better understanding of the basic cellular disturbances involved. As a result it has been shown that the mitotic activity of a variety of cells from representative unicellular, invertebrate, amphibian, mammalian, and higher plant organisms is peculiarly sensitive to inhibition by minimally effective doses. For example, mild exposure of yeast cultures to sulfur mustard can produce an immediate reduction in growth rate which may be sustained at reduced levels by several succeeding generations of daughter cells before recovery is apparent (*50, 51*). Similarly, the early cleavage of the sea urchin egg is inhibited or retarded by brief immersion of either the unfertilized egg or the early zygote in minimally effective concentrations of the mustards (*52*). The exposure of young salamander larvae elicits an immediate cessation of growth which can be attributed to an inhibition of mitotic activity in the proliferating regions of all the tissues of the embryo (*53*). Those cells in which mitotic activity has been completed at the time of exposure continue functional differentiation in a normal manner. Following direct application of threshold amounts of the mustards to the intact eye or after parenteral administration of minimal lethal doses, the corneal epithelium of mammals can be largely depleted of mitotic figures for a period of several days without visible evidence of concomitant cytoplasmic or nuclear damage (*54*). Moreover, for several days after the parenteral administration of doses sufficient to cause lymphopenia and granulocytopenia in rats, mitotic activity is decreased in lymphoid, myeloid, and erythroid cells of hematopoietic tissues which have escaped the initial destruction caused by the agents (*27, 34, 54*) as well as in the intestinal mucosa (*54*). Finally, the mitotic rate of regenerating cells following partial hepatectomy has been found to be significantly lowered by the intravenous injection of sulfur mustard (*55*). In this regard it is important to note that similar doses do not evoke visible pathological changes in normal, nonproliferative hepatic tissue.

The inhibition of mitosis caused by mild exposure to the mustards does not in itself imply a primary nucleotoxic action of the agents; in fact, the mitotic arrest appears to be confined to the resting phase of the mitotic cycle (*52, 54*). Cells in active mitosis at the time of exposure complete their division with the result that ultimately the inhibited tissue may become depleted of mitotic figures (*54*). However, evidence of a more direct toxic action on nuclear mechanisms is the appearance of extensive nuclear fragmentation in cells of the corneal epithelium which have been exposed to doses somewhat higher than those which effect only a mitotic inhibition (*54*). The nuclear fragmentation and resultant chaotic chromatin dispersal can be considered as a pathological and incomplete mitosis (*56*). More convincing of the association of mitotic arrest with primary nuclear damage are studies on the inhibition of mitosis of pollen grains following exposure of *Tradescantia* inflorescences to minimal concentrations of sulfur mustard (*57*). The fate of the treated cells was shown to vary with the extent to which chromosomal abnormalities were elicited. Thus, severe exposure in association with complete mitotic arrest caused multiple chromosome breaks resulting in fragmentation, pycnosis, and ultimate death of the cell. Mild exposure which prolonged the resting period of the pollen grains caused chromosomal breaks in many of these cells. If these were not too numerous or followed by translocation, they were transmitted to daughter cells in the subsequent mitosis as heritable chromosome abnormalities.

Perhaps the most significant demonstartion of specific nucleotoxic action has been obtained from observations on the profound disturbances produced by the mustards on the structure and function of chromosomes in *Drosophila melanogaster* (*58*). Exposure of both male and female adults to sublethal doses was found to reduce or suppress fertility through disturbances of miosis and mitosis in the gametogenesis of both sexes. However, following exposure of adult males to lower doses which did not reduce fertility unduly, the genetic analysis of the X-chromosomes revealed a high incidence of sex-linked lethals greatly in excess of the natural rate of mutation as well as a significant number of translocations and inversions. No other class of chemical agents has been shown to have such specificity of action on chromosomal mechanisms. Indeed in the past similar effects have been attained to the same degree only by the use of short-wave radiation (X-ray and ultraviolet).

That the mustards can exhibit a primary nucleotoxic action is attested by the above demonstration that in threshold doses they act directly on the intimate structure of chromosomes, without apparent influence on other cellular entities, to produce an inheritable chromosomal abnormality which can be reproduced indefinitely by normal processes of cell division and thereby transmitted from ovum to ovum through several successive adult generations. The precise mechanism whereby changes in the chromosome are effected, whether by direct chemical reaction with its component compounds or as the result of structural instabilities induced by inactivation of intimately associated nuclear enzymes, is a subject of future investigation. Of possible importance in this regard are observations on the inactivation of the infectivity of the nucleoprotein tobacco mosaic (*20, 59*) and bushy stunt (*59*) viruses. Although reaction of the viruses with the mustards resulted in extensive inactivation, moderate exposure which did not appreciably reduce infectivity was not accompanied by significant increases in mutation. It has been shown that under the latter conditions the virus molecule sustained multiple reactions with mustard groups.

On the basis of the marked susceptibility of nuclear mechanisms it is provocative to associate the cytotoxic action of the mustards with primary disturbances of nuclear function. Even the necrotization of hematopoietic and intestinal cells of mammals following fatal intoxication might conceivably be considered the eventual outcome of a primary nuclear derangement. However, it must be pointed out that abnormalities which cannot be readily interpreted as arising from a primary nuclear intoxication have been reported to result from exposure of cells to the mustards. Thus, the response of avian erythrocytes or their nucleated ghosts to the swelling action of applied detergents was demonstrated to be highly susceptible to inhibition by prior immersion in dilute solutions of the mustards (*60*). The inhibition of swelling has been interpreted to result from a primary change in the properties of the cytoplasmic stroma. Similar observations obtained with suspensions of rabbit bone marrow and lung cells (*60*) indicate that the effect is not limited to the avian erythrocyte. Although the significance of this cytoplasmic change is not clear, it does represent one of the most sensitive cellular reactions so far demonstrated to result from exposure to the mustards. Similarly, the application of dilute solutions of sulfur mustard to *Nitella flexilis* caused a marked loss of turgor associated with a loss of the normal semipermeability of the surface films to electrolyte (*61*). Finally, cytoplasmic changes have been noted in response to minimally effective doses of the mustards under circumstances which have not permitted an exact analysis of the sequences of morphological events. Thus, concentrations which inhibit the growth of cultures of choroid and sclerotic chick tissue cause a simultaneous swelling of cytoplasmic fat globules (*62*). Similarly, in cultures of embryonic membrane bone the first signs of injury are evident in the mitochondria, which undergo marked structural changes (*63*). It may also be mentioned that ameboid movement of leucocytes and metamyelocytes in suspensions of rabbit bone marrow is readily inhibited in the presence of nitrogen mustard (*46*).

CLINICAL APPLICATIONS

The marked effects of the mustards on lymphoid tissue, coupled with the finding that actively proliferating cells are selectively vulnerable to the cytotoxic action of the mustards, suggested the therapeutic use of these compounds in the treatment of neoplasms of lymphoid tissue. Because of its undesirable physical properties and extreme chemical reactivity, sulfur mustard does not lend itself to parenteral administration. However, nitrogen mustards in the form of their hydrochloride salts are water-soluble, crystalline compounds, which can be readily dissolved in sterile saline for intravenous administration. Experiments on transplanted lymphosarcoma in mice revealed that dissolution of such tumors could be rapidly effected although the dose required bordered on the toxic, and the tumor invariably returned (*64*). The first clinical trial of the nitrogen mustards (*65*) was conducted on a group of six patients in the terminal stages of various neoplastic diseases. In two cases of lymphosarcoma in which X-ray therapy had been discontinued, a rapid dissolution of large tumor masses followed a course of injections. The results were sufficiently encouraging to warrant further clinical experimentation. To date approximately 150 patients have been treated by several groups of investigators (*66–68*). For the most part observations have been limited to selected cases of Hodgkin's disease, lymphosarcoma, and leukemia. The findings may be summarized in general terms. The most favorable effects have been obtained in patients with Hodgkin's disease. Remissions characteristic of those which follow careful X-ray therapy have been observed. Symptoms were quickly alleviated, and physical evidence of lymphadenopathy, splenomegaly, and hepatomegaly regressed. It was necessary to repeat treatment at intervals varying from one to eight months. Less favorable results have been obtained in cases of lymphosarcoma. The response in acute and chronic lymphogenous and myelogenous leukemias has been disappointing.

The action of the available nitrogen mustards on lymphoid tissue has not yet reached that degree of specificity which precludes undesirable actions on the hematopoietic system. At present, dosage is limited by the occurrence of moderate granulocytopenia, thrombocytopenia, and anemia. However, if care is taken with dosage, an adequate clinical response may be obtained without affecting to a serious degree the formed elements of the blood. In addition, nausea and vomiting are very likely to occur for a brief period after each injection. No other undesirable effects on the gastrointestinal tract have been observed.

Comments. Although some patients receivir trogen mustards have been observed for a period of 28 months, the evaluation of the clinical status of this group of compounds will require many more years of careful study. At present there is no basis for assuming that the therapeutic efficacy of the nitrogen mustards is any greater than that of X-ray.

It is possible that the potential value of the nitrogen mustards in the treatment of neoplastic diseases will be fully realized only when the opportunity to explore the relationship between chemical constitution and pharmacodynamic action has been exhausted. At present only two of the nitrogen mustards have been investigated clinically, namely, *tris*(β-chloroethyl)amine and methyl-*bis*(β-chloroethyl)amine. These have been the product of a screening program designed for the evaluation of toxic chemical warfare agents rather than of compounds of therapeutic interest. Literally hundreds of congeners remain to be synthesized and evaluated. Thus, a series of compounds which can reproduce in many ways the cellular effects of X-rays is available for chemical and biological investigation. It may be hoped that the previous successes which have characterized the evolution of chemotherapeutic agents by chemical alteration of a parent compound may be duplicated in the case of the β-chloroethyl amines. The result would be a compound having a sufficiently specific toxic action for certain types of proliferative cells to possess therapeutic value.

(See p. 436 for list of references.)

Science and Our Future

E. U. Condon, *Director*
National Bureau of Standards, Washington, D. C.

THE WAR'S DESTRUCTION FAR EXCEEDS that of any catastrophe yet known. The war ended with the application of a new weapon that is a thousand times more frightful than the weapons which produced most of the war's frightfulness. And already we have responsible statements from scientists who effected this development that bombs a thousand times more powerful than those already used are capable of being made in the near future. There are men living who know how to make a single bomb whose destructiveness is equal to a million ten-ton blockbusters. One such bomb, dropped on Washington or any other major city, may be expected to wipe out its population, to destroy its buildings utterly, and to render the site uninhabitable due to poisoning by radioactive materials.

In the face of this situation, people react essentially in one of two ways. One group says: "It's just another weapon. Mankind learned to adapt to the long bow, and the cross bow, and the B-29. We have always had wars." An extreme expression of this kind is found in a speech delivered in Philadelphia last December by Prof. Leslie A. White, of the Anthropology Department of the University of Michigan, who said: "As for the extermination of the human race as a consequence of hurling atomic thunderbolts, this too may be admitted as a possibility, and all we can say is that if it is to come, it will come." This is indeed a rather coldly hopeless, fatalistic expression. Prof. White further says: "Extravagant expressions of horror will not alter the course of events."

There is a certain rhetorical trick here in that, in our language, "extravagant" connotes exaggeratedly inaccurate, and thus emotionally detracts from the serious warnings which responsible physicists are trying to give us. I would agree that expressions of horror *alone* will not alter the course of events. But I insist that if we look at what civilization has suffered in World War II, even before the atom bomb, and couple it with the picture of a war with plentiful use of the old-fashioned "one-hoss shay" atom bombs, and further with the picture of a war with both sides equipped with the really potent 1950 models—then no expression of horror of which our hearts are capable can be exaggerated or extravagant. We need not, and should not, fatalistically await death, reading papers to an academic society meeting in a museum in Philadelphia.

The second kind of people react differently. We say: "This is the end." Mankind has brought down suffering and death on its head, spiritual values have been destroyed, hatreds have been nourished and developed into great social cancers by war, war fears, and war suspicions and divisions among men.

From an address delivered 5 March 1946 in Washington, D. C., at the conclusion of the Fifth Annual Science Talent Search (*Science*, 1946, 103, 336). The guests for the evening were the 40 winners from the Science Clubs of America who received the Westinghouse Scholarships and scientists from the Washington area. The event was arranged by Science Service, whose director, Watson Davis, served as toastmaster.

This has been going on since the beginning of time and will surely destroy us all if we let it continue. This second kind of people say simply that this must stop. We say there is such a thing as progress toward a higher level of development. With all the stumbling and fumbling, we see an upward trend throughout human history. We read the lesson of history to be that men can go forward together, and that men can progress to new freedoms and new areas of social adjustment.

We see that man's growing mastery over the forces of nature also serves to amplify the magnitude of the social crises which confront him. Centuries ago, wars were local affairs; however terrible, they affected only relatively small sectors of civilization. But the last two major wars were world wars in a true sense. Their damage literally affected everyone. We face a situation in which a future world war, employing atom bombs, rockets guided by radio, and many other marvels of man's perverted ingenuity, will achieve a destructiveness thousands of times greater than ever achieved before. The magnitude of the crisis is such that we must soberly think of the choice as being between drifting into a war which will lead to the destruction of civilization, leaving a remnant of stunned, confused, poverty-stricken, frightened men and women amid the ruins, or a wholesome healthy development of a united mankind, using its intelligence cooperatively for the good of all.

I beg of you, cast in your lot with the persons of the second kind—those who believe there is a possibility that men throughout the world can live in freedom and justice, in love and good will, that they can devote their full energies to constructive application of the rational thinking to call science to the arts of peace. In asking you to join with us, I make no promise of certain security. I only promise hope and tell you that the other way leads to certain doom. If we try to establish the brotherhood of man on earth, we may fail, but if we do not even try, we shall surely fail—and what an unbearable load of guilt our consciences will then have to carry!

So much for the generalities of the situation in which we find ourselves. Now I would like to comment a little more specifically on the immediate choices which lie before us.

We must assert ourselves in every kind of agency of world cooperation toward positive, wholesome working-together for human welfare. This means the fullest kind of active support to the efforts of peoples everywhere to go forward, in political and economic freedom, to the highest level of educational, scientific, and cultural achievement. This means, specifically, support to UNO, UNRRA, UNESCO, and whatever other such activities lie ahead.

We must particularly seek to bring about closer working relationships with our friends and allies, the Russians. Russia and the United States are today the most powerful nations in the world. Unless we can get along together, there is no hope for peace. We must seek to recapture something of the feeling of joy and pride we had in being on their side, after Stalingrad and during their long, arduous drive to push the Nazi war machine out of their devastated lands. We must welcome their scientists to our laboratories, as they have welcomed ours to theirs, and extend the base of scientific cooperation with this great people. Of course, we must behave this way toward the scientists of all nations—I only mention Russia because she is right now the target of attack by those irresponsibles who think she would be a suitable adversary in the next world war.

We must regain for all scientists that freedom from military domination which is so necessary if science is to be used for peaceful ends. With Nazism not wholly exterminated, we must have scientists contributing to the development of our tools of war, since we may, if all else fails, have to use them. But the scientific life of the country must not be subordinated to, or derive its chief support from, the military.

This is essential in the interests of the military themselves. Because the scientific spirit is so completely opposite to the military spirit, science simply will not go forward under domination. Nowadays men must work together in large organizations. It is characteristic of the military organization that operations are planned and directed from the top, with the details executed by men below, by persons who unquestioningly and obediently respond to the orders given them from above. The flow of original thinking is from the top to the bottom. I conceive just the opposite to be true in a properly administered scientific organization. The function of a scientific director is to set up working conditions where the lowliest novitiate is put in touch with all the problems in his field and encouraged to worry about them and to come out creatively with new ideas and results. He is the sole judge of what knowledge he needs in order to work effectively on his problem. The flow of original thinking in this case is mainly from the bottom to the top. Every worker must have access to the whole story because no one can foresee which scientist will have the truly creative idea. And each scientist must be free to discuss his ideas, while in the formative state, with his colleagues anywhere, for it is from the working together of many minds that new science comes.

In contrasting the military and scientific, I do not wish to imply that one is wholly wrong and the other wholly right. Just as I do not recommend the military procedure for the conduct of scientific research, neither would I want our safety to depend on the outcome of a battle in which the scientific method of free discussion, independent thinking, and mutual criticism was followed by all the captains and lieutenants on the battlefield. Military operations and scientific research are two quite different kinds of human activity, and neither should be subordinated to the other.

Of course, my reason for stressing this point is that right now we are confronted in America with a situation in which scientists are being held very strictly under military domination, to the severe detriment of our scientific development and the development of wholesome international relations.

What is going on? Prominent scientists are denied the privilege of traveling abroad. Physicists are not allowed to discuss certain areas of their science with each other, even as between individuals working on closely related phases of the same subject. They can communicate only through official channels involving censorship of their communications by army officers without knowledge and so without competence. Information essential to understanding is being denied to students in our universities, so that, if this situation were to continue, the young students we honor here tonight will get from their professors only a watered-down army-approved version of the laws of nature.

In this connection one is reminded of the eighteenth verse of the eighth chapter of *Ecclesiastes*, where we read: "Wisdom is better than weapons of war; but one sinner destroyeth much good."

Some seem to think that the laws of nature are ours exclusively, and that we can keep others from learning by locking up what we have learned in the laboratory and not telling it to our allies. Later they will learn what we know—and more which, because of our unfriendly behavior, we cannot expect them to tell us. In the course of time, because of such provocations, we are allies no more—we start as friends and end as snarling, suspicious neighbors.

It is sinister, indeed, how one evil step leads to another. Having created an air of suspicion and mistrust, there will be persons among us who think other nations can know nothing except what is learned by espionage. So, when other countries make atom bombs, perhaps much better than those we have, these persons will cry "Treason!" at our scientists, for they will find it inconceivable that another country could make a bomb in any other way except by aid from Americans.

Let us cast this isolationist, chauvinist poison from our minds before we corrode our hearts and arouse suspicions of our motives in the minds of the decent peoples of the world. Let us cooperate wholeheartedly with the other nations of the world to agree to use atomic energy only for peaceful purposes and to set up an inspection system to enforce such agreement. The United Nations Assembly has voted unanimously to establish an Atomic Energy Commission to draw up such a plan. In the face of the frightfulness of atomic warfare, it is inconceivable to me that any nation will refuse to participate in a program of international cooperation and inspection. Yet, much public discussion, and even more private conversation, is based upon the assumption of such a refusal. We must push forward with all possible speed in order to find out where we stand in the world today so that it is no longer possible for different groups and different nations to base their thinking and their planning upon different hypotheses. I am confident that if we do this, the outcome will be world friendship and cooperation and not atomic war and the destruction of civilization.

Scanning Science—

Nature states that the Toronto Local Committee are assiduously engaged in preliminary work for the meeting of the British Association for the Advancement of Science in 1897. Meetings of the executive committee are held every fortnight. Besides the executive committee, a number of sub-committees are at work, including those on finance, conveyances, publication and printing, rooms for offices, meetings of the association and committees, hotels and lodgings, press, hospitality, reception and for securing cooperation of other institutes, associations and corporations, postal, telegraph and telephone facilities.

—27 March 1896

Obituary

George Dunlap McLaughlin

1887-1945

George D. McLaughlin, director of the B. D. Eisendrath Memorial Laboratory, Racine, Wisconsin, and a leading scientist in the field of leather chemistry, died suddenly on 15 October 1945. His death at the age of 58 ended an unusual career.

He was born at the little town of Retort, Center County, Pennsylvania, in 1887. After finishing high school at Buena Vista, Virginia, young McLaughlin, who, as a boy, had been fascinated by the work of a chemist in a near-by plant, served first as chemist's helper and later, at 19, despite a slender academic background, was given the responsible position of chief chemist of the Leas and McVitty plant in Buena Vista. In 1912 he moved to Benicia, California, where he was chief chemist for Kullman, Salz and Company.

In 1919 McLaughlin dropped industrial work and went to the University of Cincinnati, where he felt he could find opportunity for study and research as a means for seeking answers to many problems that he had found in practical work. At Cincinnati he held a research associateship in physiology. This two-year period of study brought an unexpected reward. The leading tanners of the country had, for several years, maintained a central research laboratory in New York City. They wished to expand this activity and were in need of a director who possessed enthusiasm, scientific curiosity, practical knowledge, and the ability to work with people. McLaughlin accepted the offered position after the tanners had agreed to an unusual proposal from him. The laboratory was to be moved to Cincinnati, was to be associated with the University there, and, when so located, was to deal with fundamental research rather than "plant problems."

A separate laboratory building was designed, built, equipped, and staffed under McLaughlin's direction and was soon producing basic and fundamental scientific findings for both science and industry. Young men were added to the staff from time to time. Many of them later went out into work elsewhere, carrying the benefits of McLaughlin's training and stimulating approach.

Moreover, he held a post in the University—as one of his friends said, that of "dean without portfolio," for his administrative skill and understanding of personnel questions, coupled with his close friendship with the deans of the Engineering and Graduate Schools, Dr. Herman Schneider and Dr. Louis T. More, drew him increasingly into the role of adviser on university problems. Thus, his influence was widespread in the local community and was extended, with his wife's, pianist and painter, to the artistic and intellectual life of the city.

By 1931 administrative duties had pyramided, leaving little time for research work. Again opportunity and the chance to create another research group was at hand. The result was the B. D. Eisendrath Memorial Laboratory at Racine, unique in the tanning industry and made possible by his friend, David B. Eisendrath, president of the B. D. Eisendrath Tanning Company. More research and further contributions to science and industry followed. His last work was as senior author of the recently published American Chemical Society Monograph, *The chemistry of leather manufacture,* into which he poured his unusual combination of practical but well-considered experience and keen and painstaking research.

In recognition of his work and contributions he was awarded the honorary degree of Master of Science by the University of Cincinnati in 1924. In 1937 he became the first recipient of the Fraser Muir Moffat Gold Medal, awarded by the Tanners' Council Research Foundation. He had served as president of the American Leather Chemists Association, of the Cincinnati Section of the American Chemical Society, and of the Cincinnati Chapter of Sigma Xi.

Despite his deep and active interest in his studies, his thoughtful mind ranged far beyond his scientific work. Enthusiastic over history, widely read in philosophy, a lover of music and the graphic arts, he was serving as chairman of the Racine Art Association at the time of his death. A special fund, set up in his name by contributions from friends and admirers, has been established to further the work of the Wustum Museum of Fine Arts in Racine.

Such men as George McLaughlin, beginning as apprentice chemist and rising through his ability, probity, and energy to leadership in his profession, reaffirm in practice the very best traditions of the American democracy to which he was so devoted.

CHARLES H. BEHRE, JR.
Department of Geology, Columbia University
DAVID B. EISENDRATH
B. D. Eisendrath Tanning Company
Racine, Wisconsin

Technical Papers

Some Physical and Biologic Properties of Subtilin and Other Antibiotics[1]

HAMILTON H. ANDERSON, GILBERTO G. VILLELA, EDER LINDSAY HANSEN, and RACHEAL K. REED

Division of Pharmacology and Experimental Therapeutics, University of California Medical School, San Francisco

Subtilin, an antibiotic obtained from *Bacillus subtilis* by Jansen and Hirschmann in 1944 (*4*), was found to be active *in vitro* against *Staphylococcus aureus, Lactobacillus casei, Micrococcus conglomeratus,* and *Streptococcus viridans.* Salle and Jann (*10*) have indicated that it is also active *in vitro* against gram-positive bacteria including *Mycobacterium tuberculosis.* It was reported by them to have a cytotoxic index of about 20. Because of its favorable antibiotic activity we desired to investigate possible modes of action against a variety of organisms. Effects on *Trypanosoma equiperdum, Leishmania donovani, Endamoeba histolytica, Lactobacillus plantarum,* and *Ascaris suis* were studied. In addition, physical behavior was considered in an effort to explain the biologic activity of subtilin and other antibiotics *in vitro* and *in vivo.*

Using the technic of Heilman and Herrell (*3*), subtilin,[2] 0.05 per cent in water or in 85 per cent ethyl alcohol, showed immediate surface-tension-lowering effect. Gramicidin, as noted by Heilman and Herrell (*3*), and gramicidin derivative (formaldehyde treated), prepared by Lewis, *et al.* (*6*), exhibited similar properties. Lysozyme and streptomycin[3] produced only slight effects, while penicillin[4] did not alter surface tension. Fig. 1 summarizes our findings. The Cenco-Du Noüy tensiometer was used.

The hemolytic effect of gramicidin, reported by Heilman and Herrell (*2*), was compared with that of the other antibiotics. Confirming the studies of Lewis, *et al.,* gramicidin derivative proved less hemolytic. Subtilin had no immediate effect on red cells, but after 24 hours at 4° C. hemolysis occurred. Penicillin and streptomycin caused no hemolysis, thus confirming Van Dyke (*11*) with respect to penicillin.

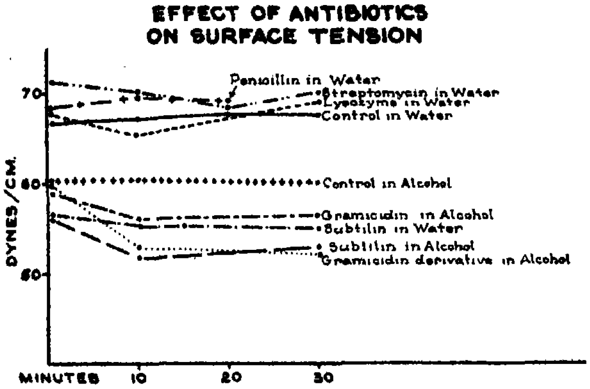


FIG. 1

Brief exposure of *T. equiperdum* to subtilin dissolved in 0.45-per cent sodium chloride solution resulted in immediate cytolysis when 1:2,000 dilution was used. Streptomycin and penicillin were not lytic. Survival of trypanosome-infected mice was not prolonged when 80 to 160 mg./kg. amounts of subtilin were given intraperitoneally.

Using a previously described technic (*7*), subtilin was not active *in vitro* or *in vivo* against *L. donovani.* Penicillin G in 1:1,000 dilution caused cytolysis of leishmania in 6 hours, and in 1:10,000, in 24 hours. *In vivo* it was not active. Neither streptomycin nor lysozyme was effective *in vitro.*

E. histolytica was killed *in vitro* in liquid liver medium (*1*) at 1:400,000 dilution of subtilin, as well as the associated bacterium 't'. In egg slope medium it was active within the range of emetine hydrochloride, and on autoclaving solutions for 10 minutes, subtilin's activity was markedly enhanced. The gramicidins had similar activity in egg slope medium, but were only one-fifth as active as subtilin in liquid liver medium. Streptomycin in 1:2,500 dilution killed the ameba *in vitro.* Penicillin has been reported ineffective (*8*). One monkey (*Macacus rhesus*) was cleared of *E. histolytica* for three weeks after 1.0 gram/kg. total oral doses in 10 days.

Against *L. plantarum* (342y) in liquid medium containing 1 per cent dextrose and 1 per cent Difco yeast extract (pH 6.8), a 1:80,000 dilution of subtilin inhibited growth after 48 hours at 37° C. Cholesterol did not enhance its activity, but para-aminobenzoic acid did. The gramicidins were active at 1:40,000 dilution and streptomycin at 1:10,000.

---

[1] Part of a cooperative study with Dr. Howard D. Lightbody and associates, Western Regional Research Laboratory, U. S. Department of Agriculture, Albany, California, who produced the antibiotics reported (unless otherwise acknowledged); together with Dr. A. J. Salle, Department of Bacteriology, University of California at Los Angeles. Studies in the University were supported, in part, by Eli Lilly and Company, Indianapolis, Indiana, and the Committee on Medical Research, Office of Scientific Research and Development, under contracts with the University of California. Acknowledgment is made to Dr. Benedict E. Abreu and to Mrs. Elsa Zitcer, who performed some of the toxicity tests in mice.

[2] Amounts of antibiotics are expressed on the basis of weight of dry materials, except for penicillin (C.S.C.).

[3] Generously supplied by the Lilly Research Laboratories, Indianapolis, Indiana: streptomycin, 850 units/mg.; penicillin G, 1,650 units/mg.

[4] Sodium salt, prepared by Commercial Solvents Corporation.

In vitro tests against *A. suis*, using the technic of Lamson and Brown (*5*), revealed that none of the antibiotics studied was active.

The acute toxicity of subtilin in mice, on intravenous injection of 1 per cent solution, was LD_{50} (60 ± 3 mg./kg.); on subcutaneous injection, the LD_{50} was 670 ± 30 mg./kg.; when given intragastrically, 5.0 grams/kg. killed. One per cent solution instilled into the rabbit's eye was nonirritating.

Gramicidin, 1 per cent in propylene glycol, given intravenously in mice had an LD_{50} of 1.5 mg./kg. This is slightly lower than reported by Robinson and Molitor (*9*). Gramicidin derivative was less toxic, LD_{50} being 4.7 mg./kg. Lethal doses of the gramicidins killed within one minute, which precluded the possibility of delayed hemolysis being responsible.

Summary. Subtilin, a new antibiotic obtained from *B. subtilis*, proved active *in vitro* against *L. plantarum, E. histolytica* and its associated bacterium 't', and *T. equiperdum* without causing immediate hemolysis of erythrocytes. Subtilin is tensioactive, and amounts required for antibiotic effect are within the range of surface tension activity. It was relatively nontoxic for four species of mammals, especially after intragastric administration. Gramicidin is more hemolytic and more toxic than subtilin.

References

1. HANSEN, E. L. *Fed. Proc.*, 1945, **4**, 122.
2. HEILMAN, D., and HERRELL, W. E. *Proc. Soc. exp. Biol. Med.*, 1941, **46**, 182.
3. HEILMAN, D., and HERRELL, W. E. *Proc. Soc. exp. Biol. Med.*, 1941, **47**, 480.
4. JANSEN, E. F., and HIRSCHMANN, D. J. *Arch. Biochem.*, 1944, **4**, 297.
5. LAMSON, P. D., and BROWN, H. W. *Amer. J. Hyg.*, 1936, **23**, 85.
6. LEWIS, J. C., DIMICK, K. P., FEUSTEL, I. C., FEVOLD, H. L., OLCOTT, H. S., and FRAENKEL-CONRAT, H. *Science*, 1945, **102**, 274.
7. REED, R. K., and ANDERSON, H. H. *Fed. Proc.*, 1945, **4**, 133.
8. REES, C. W., and REARDON, L. V. *Trop. Med. News*, 1944, **1**, 18.
9. ROBINSON, H. J., and MOLITOR, H. *J. Pharm. exp. Therap.*, 1942, **74**, 75.
10. SALLE, A. J., and JANN, G. J. *Proc. Soc. exp. Biol. Med.*, 1945, **60**, 60.
11. VAN DYKE, H. B. *Proc. Soc. exp. Biol. Med.*, 1944, **56**, 212.

A Relation Between Size of the Divalent Cation and Solubility of Triple Acetate Salt of Sodium

LOCKHART B. ROGERS
Stanford University

The importance of the size of the alkali metal cation to the formation of the triple acetate salt, $NaM^2UO_2(OAc)_9 \cdot 6H_2O$, was first demonstrated by Caley and Baker (*2*) when they proved that potassium, unlike lithium and sodium, formed only a double salt. In their paper, they listed the divalent ions which form triple acetate salts with sodium in an order of decreasing sensitivity toward sodium. Their list is reproduced in Table 1, together with the empirical ionic radii of Pauling (*5*) and the atomic radii of Goldschmidt (*3*). It can be seen that the solubility of the triple salt increases with the radii of the ions, whereas it bears no relation to the radii of the atoms.

TABLE 1

RADII OF DIVALENT CATIONS WHICH FORM TRIPLE ACETATE SALTS ARRANGED IN ORDER OF DECREASING SENSITIVITY OF THEIR RESPECTIVE REAGENTS TOWARD SODIUM

Cation	Radii in Angstrom Units	
	Ionic	Atomic
Mg	0.65	1.62
Ni	0.70	1.24
Co	0.72	1.26
Zn	0.74	1.37
Fe	0.75	...
Mn	0.80	1.36
Cu	...	1.28
Cd	0.97	1.52
Hg	1.10	1.55 (liquid)

Caley and Baker did not assign a position to the ferrous acetate reagent because the difficulties involved in handling it made its exact position in the group uncertain. However, the value of the ionic radius of the ferrous ion establishes the position of reagent between those of zinc and manganese.[1]

TABLE 2

RADII OF ALKALINE EARTH METALS OTHER THAN MAGNESIUM

Cation	Radii in Angstrom Units	
	Ionic	Atomic
Be	0.31	1.05
Ca	0.99	2.21
Sr	1.13	....
Ba	1.35	....

Likewise, if the assumption is correct that the solubility varies with the ionic radius, one should be able to assign a value to the radius of the cupric ion because the sensitivity of its reagent is known. Unfortunately, the limits are very wide, so additional information must be sought. The radius of the cuprous ion is known (0.96 A.—Pauling), as is the magnitude of the change in the radius resulting from the loss of an electron by the ferrous ion (0.15 A.). Although the conditions are not exactly the same for the ferrous ion and the cuprous ion, they are sufficiently similar to enable one to guess that the radius of the cupric ion is approximately 0.81 A.

From Table 2 one might predict that the radii of the divalent ions of the alkaline earth group do not fall into the range of those of the heavy metals and therefore are not likely to form triple acetate salts. One must admit, however, that other factors, such as the solubility of an individual acetate or the solubility of a double salt, together with the coordination number of the ion, may limit the possibility of the formation of a triple salt. It is interesting to note, therefore, that although a triple acetate has been reported for beryllium (*1*), the findings are open to question according to the work of another investigator (*4*). To date, no triple acetate has been reported for calcium, although very early work (*6*) reported two varieties of double salt, one of which might have been a triple salt. No triple salts of strontium or barium are known. Hence, it appears that the size of the ionic radius of a divalent ion not only affects the solubility of the triple acetate salt within the group listed in Table 1 but also provides a means of predicting whether or not any divalent cation is likely to form a triple acetate salt.

---

[1] In a private communication, Dr. Caley stated that this position is consistent with his observations.

References

1. Cagliotti, V. *Rend. Accad. Sci. Napoli.*, 1927 (3A) **33**, 177, 179; through *Gmelins Handb. anorg. Chem.*, 1936, **55**, 228.
2. Caley, E. R., and Baker, A. L. *Ind. eng. Chem.* (Anal. ed.), 1939, **11**, 604–607.
3. Ephraim, F. *Inorganic chemistry.* (3rd Engl. ed. by P. C. L. Thorne and A. M. Ward.) London: Gurney and Jackson, 1939. Pp. 36–37.
4. Miholic, S. S. *Izvjesca Raspk. mat-pripod. Razr.* (Zagreb), 1920, **13–14**, 16, 21; through *Gmelins Handb. anorg. Chem.*, 1936, **55**, 228.
5. Pauling, L. *The nature of the chemical bond.* (2nd ed.) Ithaca, N. Y.: Cornell Univ. Press, 1940. Pp. 346, 350.
6. Rammelsberg, C. *Ber. Berl. Akad.*, 1884, 866; through *Gmelins Handb. anorg. Chem.*, 1936, **55**, 230.

The Mechanism of the Therapeutic Effect of Iodine on the Thyroid Gland

Eduardo De Robertis and Wiktor W. Nowinski
Instituto de Anatomía General y Embriologia
Universidad de Buenos Aires

It is now a well-established fact that in cases of toxic goiters the iodine produces an effect which, clinically, shows relief of the symptoms and, biochemically, decrease of the circulating thyroid hormone and an increase in the gland of total iodine, both free and organically bound. Histologically, this effect is manifested by the deposit of the colloid inside the follicles. These facts are generally interpreted as a blockage of the release of the secretion by iodine, but its mechanism is still not very well understood.

The theory of a mechanical blockage, supported by several authors (*5, 6*), can be hardly maintained in view of the modern concepts of enzymatic chemistry and histophysiology of the thyroid gland.

Salter and Lerman (*7*), as the result of a study of enzymatic synthesis carried out with proteases as catalysts, suggested that the therapeutic effect of iodine is due to the mass-law phenomenon, which acts by "forcing" the reaction in the direction of a synthesis and, in this way, inducing the colloid formation and storage.

In 1941 one of us (*1*) demonstrated that the colloid of rat thyroids, extracted from a single follicle, has a definite proteolytic activity, and established a correlation between this activity and the function of the thyroid gland. From these results, later confirmed by Dziemian (*3*), the conclusion was drawn that in the reabsorption of the colloid an enzymatic mechanism is involved which is responsible for the proteolysis of thyreoglobulin. It also was found that iodine, after a certain time, inhibits this proteolytic activity.

TABLE 1

PROTEOLYTIC ACTIVITY OF TOXIC GOITERS BEFORE AND AFTER TREATMENT *in Vitro* WITH IODINE

Blank Mg. of tyrosine and tryptophane set free	Iodinized extract Mg. of tyrosine and tryptophane set free	Per cent inhibition
0.116	0.031	73.3
0.164	0.035	77.1
0.094	0.042	55.3
0.225	0.105	53.4
0.092	0.011	88.5

Recently we found (*2*) in human thyreotoxicosis that the proteolytic activity of the total gland, as measured by the amount of tryptophane and tyrosine set free, is probably also decreased through the action of iodine administered in therapeutic doses. These results and those of Henrriott (*4*) on the inhibition of pepsin activity by iodization *in vitro*, led us to suppose that in the case of iodine treatment the clinical effect is due to an inhibition of the proteolytic enzyme system.

In order to test this assumption, glycerol extracts of human thyroid gland (toxic goiters) were iodinized *in vitro* with a final concentration (0.05 M) of iodine, and the proteolytic activity was determined by the amount of tyrosine and tryptophane set free after a 4-hour incubation at 37° C. with edestin as substrate. The details of this method were described in our previous paper (*2*). Here we wish only to add that the glycerol extracts, after iodinization, were dyalized for 24–48 hours at 3° C. Also, the blank (*i.e.* the same extract, but without iodine) was treated in the same way.

Certain of the results of this experiment are given in Table 1, from which the conclusion may be drawn that, under these conditions, there is 53.4 to 88.5 per cent inhibition of the proteolytic activity of the thyroid gland. It is interesting to point out that this inhibition is due to free iodine, as control experiments with potassium iodide (which serves as a solvent medium for the iodine in our iodinization experiments) show no inhibiting effect whatever. The same may be said about the thiourea, which obviously acts through a different mechanism.

From our experiments we conclude that the therapeutic action of iodine on the thyroid gland is due to the inhibition of the proteolytic enzyme system, probably responsible for the release of the follicular colloid.

References

1. De Robertis, E. *Anat. Rec.*, 1941, **80**, 219.
2. De Robertis, E., and Nowinski, W. W. *J. clin. Endocrinol.*, in press.
3. Dziemian, A. J. *J. cell. comp. Physiol.*, 1943, **21**, 339.
4. Herriott, R. M. *J. gen. Physiol.*, 1936, **20**, 335.
5. Marine, D. *Medicine*, 1927, **6**, 127.
6. Mosser, W. B. *Surg. Gynec. Obstet.*, 1928, **47**, 168.
7. Salter, W. T., and Lerman, J. *Endocrinology*, 1936, **20**, 801.

Brain Involvement as a Possible Cause of Relapse After Treatment in Spirochetal Relapsing Fever

V. T. Schuhardt and Emmarie C. Hemphill

Department of Bacteriology, University of Texas

Schuhardt and O'Bryan (*1*) have reported that doses of 40,000+ units (per kilogram body weight) of penicillin sodium, when injected intraperitoneally over a period of 72 hours beginning at onset of the first attack, will cure blood-stream involvement and prevent most brain involvements in *Ornithodorus turicata*-transmitted relapsing fever of the white rat. Equivalent intraperitoneal doses given at later stages of the infection failed to cure brain involvement. Subsequently, these workers (*2, 3*) reported cure of brain involvement by the intracranial injection of 1,000 units of penicillin. These observations provide a means of testing the theory that relapse after treatment in spirochetal relapsing fever can be a consequence of the persistence of spirochetes in the central nervous system of the treated animals.

This tendency to relapse after treatment is a fundamental problem, not only in the case of spirochetal relapsing fever but also in that of spirochetal diseases generally. Also, the problem of therapy in neurosyphilis conceivably is related to the problems here involved. Furthermore, we believe that much of the confusion in the literature relative to the use of relapsing-fever-spirochete infected animals in testing spirocheticidal agents stems from the irregular tendency of these animals to relapse after treatment.

In our experimental work 53 rats were infected by the intraperitoneal injection into each of 0.01± ml. of onset positive heart blood from tick (*O. turicata*)-infected rats. The infection status of these rats, both before and after treatment, was followed by uniform (0.01 ml. of a 1:20 dil.), daily, dark-field examination of tail blood. Penicillin therapy was begun in the test animals on the second or third day of dark-field positivity which, in each case, was the fourth or fifth day of the infection.

Twenty-five of the rats were anesthetized with 3–4 mg. of nembutal per 100 grams body weight, and each received 1,000 units of penicillin in a single intracranial injection (0.05 ml. of a 20,000 units/ml. solution in phosphate buffer pH 7.0). Although many of these rats showed severe convulsive reactions, only 2 died as a result of this injection. The 23 surviving rats received 1 to 14 intraperitoneal injections of penicillin at three-hour intervals, resulting in doses ranging from 4,400 to 50,900 units/kg. body weight.

Nineteen rats received no intracranial penicillin, but received 1 to 16 intraperitoneal injections at intervals of three hours, resulting in penicillin doses of from 10,100 to 52,500 units/kg. body weight. These rats served as controls for comparing the effect of combined (intracranial and intraperitoneal) therapy with intraperitoneal therapy alone. Nine additional rats served as untreated controls. Eight of these relapsed one or more times during the experiment, and all 9 were brain-blood-passage positive at the end of 31 days.

Too few rats were included in the group receiving 30,000 to 40,000 units/kg. body weight intraperitoneally to draw final conclusions relative to the mini-

TABLE 1

No. rats	Penicillin therapy			No. showing microscopic relapse	Brain-blood passage results	
	Intracranial	Intraperitoneal				
	Amount	No. inj.	Units/kg.		No. passed	No. pos.
13	1,000 units	1 to 10	4,400–22,800	12	1	1
14	None	1 to 10	10,100–35,900	12	2	2
6	1,000 units	4	41,000–50,500	Not examined	6	3
4	1,000 units	10 to 14	42,400–50,900	0	4	0
5	None	10 to 16	47,000–52,500	3	2	2
9	None	None		8	9	9

mum curative intraperitoneal dose of penicillin. However, all 27 rats which received less than 40,000 units/kg. intraperitoneally either relapsed microscopically or were brain-blood-passage positive regardless of whether or not they received intracranial therapy. If we can accept the growing evidence that 1,000 units of penicillin is adequate to sterilize the brain of an infected rat, the relapses and positive brain passages in the 13 animals in this group, which received intracranial penicillin, were the consequences of inadequate intraperitoneal therapy to cure the blood stream and/or visceral tissues.

Fifteen rats received intraperitoneal penicillin totaling from 41,000 to 52,500 units/kg. body weight. Ten of these rats each received an additional 1,000 units intracranially. These 10 rats were subdivided into a group of 6 which received more than 40,000 units/kg. in 4 intraperitoneal injections and a group of 4 which received equivalent total amounts of penicillin in 10 to 14 intraperitoneal injections. The 5 remaining rats in this group, which received no intracranial penicillin, received from 47,600 to 52,500 units/kg. in 10 to 16 intraperitoneal injections.

The 6 rats which received only 4 intraperitoneal injections were not examined microscopically for relapses. Brains were passed from these animals within 6 days after treatment, and 3 were found to be positive. Since each brain passage includes varying amounts of adhering blood, we are inclined to interpret these 3 positive passages as instances of blood passage resulting from the short duration of the intraperitoneal therapy.

The 4 rats which received combined therapy and the more than 40,000 units/kg. intraperitoneally in 10 to 14 injections were examined microscopically for 31 days, during which time none relapsed. Brain passages from these 4 animals were all negative. Thus, it is again demonstrated that adequate combined intracranial and intraperitoneal penicillin therapy will cure both brain and blood-stream involvement in experimental relapsing fever.

The 5 rats which received no intracranial penicillin but received 47,600 to 52,500 units/kg. intraperitoneally in 10 to 16 injections were examined microscopically each day until they relapsed, or for 31 days. Three of these rats relapsed in 11 to 16 days. The two which did not relapse in 31 days were found to be brain passage positive and can be assumed to have been potentially capable of relapsing had the examination period been extended. This irregular relapse tendency undoubtedly has been the cause of much confusion in chemotherapeutic studies in experimental relapsing fever. We believe that the use of intracranial or intracisternal penicillin will serve as a distinct aid in future testing for the blood-visceral efficacy of other spirochetícidal agents in rats.

The results of these experiments prove that relapse after intraperitoneal treatment in experimental relapsing fever can result from spirochetes re-entering the blood after persistence in the central nervous system during the course of treatment. Undoubtedly some of the numerous instances of relapse after intravenous arsenic therapy in human relapsing fever can be explained similarly.

References

1. Schuhardt, V. T., and O'Bryan, Billie E. *Science*, 1944, **100**, 550–552.
2. Schuhardt, V. T., and O'Bryan, Billie E. *J. Bact.*, 1945, **49**, 312–313.
3. Schuhardt, V. T., and O'Bryan, Billie E. *J. Bact.*, 1945, **50**, 127.

The Ambiguity of International Antitoxic Units[1]

Ivan C. Hall

Central Laboratory, Contaminated Wound Project
College of Physicians and Surgeons, Columbia University

The labels on the bottles of commercial polyvalent antitoxin now being used in the prophylaxis and treatment of gaseous gangrene are very misleading. For example, "one therapeutic dose" of a certain brand of such antitoxin is stated to contain:

10,000 units *B. perfringens* antitoxin
10,000 units Vibrion septique antitoxin
3,000 units *B. histolyticus* antitoxin
1,500 units *B. oedematiens* antitoxin
1,500 units *B. Sordellii* antitoxin

One would naturally suppose the units of these five antitoxins to be of equal protective power; such a serum would seem to be very strong in protective action against *B. perfringens* and "Vibrion septique" (*B. septicus*), less than a third as strong against *B. histolyticus*, and only about one-seventh as strong against "*B. oedematiens*" (*B. Novyi*) and *B. Sordellii*.

As a matter of fact, no two of the international units for these antitoxins have the same protective power in terms of minimal lethal doses of their respective toxins in mice. The papers of Bengston, Stewart, and Ipsen (*2, 3, 4*), who established the international standards for these antitoxins under the auspices of the Permanent Committee of Standardization of the Health Organization of the League of Nations, show the approximate values indicated in Table 1.

It is, of course, impossible to establish and maintain an exact relationship between the number of

---

[1] The work in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Columbia University. Dr. Frank L. Meleney, of the Subcommittee on Surgical Infections, was the responsible investigator.

minimal lethal doses of different lots of toxin and a "unit" of antitoxin, owing to the varying ratios of active toxin and inactive toxoid occurring in different toxic filtrates. It is well known that both toxins and toxoids combine with antitoxins. The original standard units of diphtheria, tetanus, and botulinus antitoxins were based upon test doses of more or less stabilized toxins measured in minimal lethal doses for guinea pigs of standard weights from which an initial provisional and reasonably stable unit of serum could be defined, but it was always necessary to titrate each lot of toxin against the standard antitoxic unit when ascertaining the titer of new lots of antitoxins. And the number of minimal lethal doses in the test doses from different lots of toxin was found to vary considerably. In fact, the same antitoxin tested against different toxins equated to the same standard unit sometimes gave different values. The same principle holds for the gas-gangrene antitoxins, yet there is, in all cases, an approximate relationship between unitage and protective power. It thus appears in the above "therapeutic dose" of polyvalent gas-gangrene antitoxin that while the number of units of *B. perfringens* and *B. septicus* antitoxin is large, their protective power is greatly exceeded by a much smaller number of units of *B. Novyi* and *B. Sordellii* antitoxin.

TABLE 1

Antitoxin	Approximate number of mouse M.L.D.'s neutralized by 1 unit	Units in "therapeutic dose"	Approximate number of mouse M.L.D.'s of toxin neutralized
B. perfringens	50 to 70	10,000	500,000 to 700,000
B. septicus (Vibrion septique)	40 to 64	10,000	400,000 to 640,000
B. histolyticus	45	3,000	135,000
B. Novyi (*B. oedematiens*)	5,000	1,500	7,500,000
B. Sordellii	1,900 to 3,800	1,500	2,850,000 to 5,700,000

There has been considerable discussion as to the most desirable composition of polyvalent gas-gangrene serums. Some manufacturers, starting some years ago with a mixture similar to the above, in some cases including 1,500 units of tetanus antitoxin, subsequently eliminated all but the antitoxins for *B. perfringens* and *B. septicus* on the ground that these two were the most common causative agents in gaseous gangrene. Tetanus antitoxin was to be given prophylactically in a separate dose. But owing to the increased number of cases of infection with *B. Novyi* in the military campaign in the Middle East (*6*), recent practice has been to include *B. Novyi* antitoxin as well, omitting the antitoxins for *B. histolyticus* and *B. Sordellii* on the ground of relative infrequency. I favor the inclusion of all five in approximately equal protective ratios, because experience shows that all the above anaerobic bacilli give rise to serious wound infections, and it is impossible for a bacteriological examination to determine the significant species present in a given case in time to decide which monovalent serum should be used.

It is really unfortunate that the standardization of antitoxin serums was not developed so that an approximately equal protective power was always denoted by the term "antitoxin unit." Even the much older units of diphtheria, tetanus, and botulinus antitoxins differ from each other and from the above in relative protective power. The diphtheria unit was originally defined as that amount of serum which would protect a 250-gram guinea pig for 96 hours against a test dose (L_+) of diphtheria toxin of 100 minimal lethal doses (*5*), while the tetanus antitoxin unit was defined in the United States as 10 times that amount of serum which would protect a 350-gram guinea pig against a test dose of 100 minimal lethal doses (*7*), and botulinus antitoxin was standardized like tetanus antitoxin except that guinea pigs weighing 250 grams were used (*1*).

The gas-gangrene antitoxin units defined in terms of minimal lethal doses of toxin for mice are all different from those of diphtheria, tetanus, and botulism in terms of minimal lethal doses of these toxins for guinea pigs. Although the values overlap between *B. perfringens* and *B. septicus* antitoxins and between *B. tetani* and *B. botulinus* antitoxins, the discrepancies in the list as a whole and the over-all range are conspicuous.

Perhaps a new international committee on standardization might consider redefining antitoxic units in terms of approximately equal protective power in order to simplify as far as possible our now confused conceptions.

References

1. BENGSTON, I. A. *Abstr. Bact.*, 1921, **5**, 251; *Amer. J. publ. Hlth*, 1921, **11**, 352.
2. BENGSTON, I. A. *Publ. Hlth Rep.*, 1934, **49**, 201; 1934, **49**, 525; 1934, **49**, 1557; 1936, **51**, 266.
3. BENGSTON, I. A., and STEWART, S. E. *Publ. Hlth Rep.*, 1936, **51**, 1263; STEWART, S. E., and BENGSTON, I. A. *Publ. Hlth Rep.*, 1939, **54**, 1435.
4. BENGSTON, I. A., and IPSEN, J. *League Nat. Bull. Hlth Org.*, 1939, **8**, 856.
5. EHRLICH, P. *Klin. Jb.*, 1897, **6**, 299; *Dtsch. med. Wschr.*, 1898, **24**, 597.
6. MACLENNAN, J. D. *Lancet*, 1943, **2**, 63, 94, 123.
7. ROSENAU, M. J., and ANDERSON, J. F. *U. S. hyg. Lab. Bull.*, 1908, **43**, 59 pp.

U. S. News and Notes

Max A. Lauffer, associate professor of physics at the University of Pittsburgh, will receive at Atlantic City on 12 April the $1,000 Eli Lilly and Company Award in Biological Chemistry for his work on viruses. Dr. Lauffer will speak on "Contributions of Virus Research to Chemistry and Physics" to the American Chemical Society's Division of Biological Chemistry.

J. W. T. Youngs, of Purdue University, has been made associate professor of mathematics at Indiana University.

Dr. Homer C. Thompson, head of the Department of Vegetable Crops, Cornell University, addressed the Plant Institute of the Ohio State University on 25 February. Dr. Thompson, who received the three collegiate degrees from Ohio State, spoke on "The Importance of Micronutrients in Vegetable Production" in participating in the Twenty-fifth Anniversary Program of the Plant Institute.

Announcements

The Ella Sachs Plotz Foundation for the advancement of scientific investigation made 23 grants-in-aid during 1945, the twenty-second year of its existence. In the past, 531 grants have been distributed to scientists throughout the world. The current list follows:

Dr. Clemens E. Benda, Wrentham State School, Wrentham, Massachusetts: the development of the anterior pituitary lobe from birth to adolescence and the main patterns of pathology in various disorders.

Dr. H. Bornkopf, The Hebrew University, Jerusalem, Palestine: work on influence of rabies virus on the metabolism of brain tissue of chicken embryos and mice.

Dr. T. T. Chen, University of California, Los Angeles: publication of two-colored plates illustrating cytological studies of malarial parasites.

Dr. S. J. Crowe, Johns Hopkins University School of Medicine, Baltimore: continuation of work on chronic occlusion of the Eustachian tube by hyperplastic lymphoid tissue in the region of its nasopharyngeal orifice.

Prof. M. S. Dunn, University of California, Los Angeles: continuation of investigation of peptides.

Dr. Anna Goldfeder, New York University College of Medicine, New York City: continuation of studies on the relation between radiation effects and cell viability as indicated by induced resistance to transplanted tumors.

Dr. A. Sydney Harris, Western Reserve University School of Medicine, Cleveland, Ohio: a study of the effects of anoxia on the heart.

Dr. H. Heller, University of Bristol, Bristol, England: investigation of the renal function of newborn mammals in comparison with adult.

Dr. Harold Holck, University of Nebraska, Lincoln: work on the relation of sex to drug action.

Dr. W. Henry Hollinshead, Duke University School of Medicine, Durham, North Carolina: investigation into the functions of the abdominal chemoreceptors of the mouse and rat.

Dr. George W. Holmes, Massachusetts General Hospital, Boston: publication of material on the effect of cathode rays on the human skin.

Dr. V. Korenchevsky, Oxford, England: research on aging.

Dr. Otto Krayer, Harvard Medical School, Boston: analysis of certain phenomena of nerve and muscle related to the "veratrine response" of these tissues, and work pertaining to the distribution and activity of cholinesterase, by Drs. George H. Acheson and Ralph W. Brauer.

Prof. J. V. Luco, Santiago de Chile, South America: research in the field of neurophysiology.

Prof. Carl Neuberg, New York University, New York City: continuation of physiological investigations of the osones.

Dr. William T. Salter, Yale University School of Medicine, New Haven: study of the action of cardiac glycosides and other cardiotrophic substances upon fatigued heart muscle.

Dr. F. O. Therman, Nobel Institute for Neurophysiology, Karolinska Institutet, Stockholm, Sweden: continuation of neurophysiological research.

Thorndike Memorial Laboratory, Boston City Hospital, Boston (Prof. George R. Minot, director): in recognition of Dr. Francis W. Peabody's services to the Foundation.

Dr. Edward J. Van Liere, West Virginia University School of Medicine, Morgantown: continuation of research on the effect of anoxia and asphyxia on animals, to include intestinal absorption and motility.

Dr. William J. van Wagtendonk, Oregon State College, Corvallis: investigation of the enzyme systems responsible for the derangement of the purine metabolism during the deficiency of the antistiffness factor.

Dr. E. Wertheimer, The Hebrew University, Jerusalem, Palestine: investigation of *in vitro* synthesis of glycogen from glucose by liver and diaphragms of diabetic rats.

Prof. Richard W. Whitehead, University of Colorado School of Medicine, Denver: continuation of investigations into "diffusion respiration."

Prof. Bernhard Zondek, Rothschild Hadassah University Hospital, Jerusalem, Palestine: continuation of investigations dealing with the impairment and stimulation of the functions of the pituitary gland and especially of the gonadotropic hormones of the anterior pituitary lobe.

Applications for grants to be held during the year 1946–47 must be in the hands of the Executive Committee before 15 April 1946. There are no formal application blanks, but letters asking for aid must state definitely the qualifications of the investigator, an accurate description of the research, the size of the grant requested, and the specific use of the money to be expended. In their requests for aid applicants should state whether or not they have approached other foundations for financial assistance and what other sources of support are relied on for research. It is highly desirable to include letters of recommendation from the directors of the departments in which the work is to be done. Applications should be sent to Dr. Joseph C. Aub, Massachusetts General Hospital, Boston 14, Massachusetts.

The Joint Army-Navy-NDRC Tropical Deterioration Information Center, which operated under contract with the George Washington University during the war, has been transferred to the National Research Council under a contract between the Navy Department and the National Academy of Sciences. The project has been renamed The Prevention of Deterioration Center. The functions of this project are: (1) to maintain and operate a coordination center; (2) to maintain personal contact with all work on the prevention of deterioration; (3) to act in a consulting and advisory capacity on deterioration; and (4) to conduct certain studies in this field at the request of the Armed Forces.

The 125th anniversary celebration of the Philadelphia College of Pharmacy and Science was held on 22 February in Philadelphia. At ceremonies in the college auditorium representatives of nearby universities and colleges, learned organizations, and professional societies heard a review of the influence of the founding Quakers on Philadelphia's institutions, presented by Dr. George Urdang, director of the American Institute for the History of Pharmacy, Madison, Wisconsin.

The National Registry of Rare Chemicals, Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois, lists their new needs as follows: thianaphthene; coniferyl alcohol; uridylic acid, d- or l-fenchone; ornithin; azulene; diphenyl phosphate; 3,4-dihydroxy pyridine; trimethylene diamine; tetramethylene diamine; pentamethylene diamine; humic acid; 2-phenyl cyclohexanol; 1,1-dibrompropane; strophanthidin; digoxigenin; digitoxigenin; periplogenin; cyclobutane; pyrithiamine; 1-rhamno ascorbic acid; d-arabo ascorbic acid; α- or β-angelica lactone; tributyl boron. Please communicate regarding these directly with the Registry at the address given above.

Meetings

Three lectures on Electrical Communication—Its Roots and Branches will be given by Dr. J. Owen Perrine, assistant vice-president, American Telephone and Telegraph Company, in the auditorium of the Wagner Free Institute of Science, Montgomery Avenue and 17th Street, Philadelphia. The subjects will be: "Entangling Alliances of Electricity," 12 April; "Waves, Carriers of Power and Information," 18 April; "Radar and Microwaves," 26 April. Lectures are to begin at 8:00 P.M.; admission is free.

The newly formed Eastern Association of Electroencephalographers will meet at the Graduate Club of the Institute of Living, Hartford, Connecticut, at 1:00 P.M., Friday, 12 April 1946, at which time a draft of the constitution and bylaws will be presented by the Organization and Program Committee. Military experience in electroencephalography will be discussed by Dr. Milton H. Kibbe, who will speak of the Army, and Dr. Charles B. Henry, who will report on Navy data. This is the second meeting of the group.

Elections

Officers of the Washington Academy of Sciences for 1946 are: Hugh L. Dryden, president; F. G. Brickwedde, secretary; Howard S. Rappleye, treasurer. Vice-presidents representing the Affiliated Societies are: Francis M. Defandorf, Philosophical Society of Washington; T. Dale Stewart, Anthropological Society of Washington; Frank Thone, Biological Society of Washington; Leo A. Shinn, Chemical Society of Washington; Carl F. W. Muesebeck, Entomological Society of Washington; Alexander Wetmore, National Geographic Society; Louis W. Currier, Geological Society of Washington; Frederick O. Coe, Medical Society of the District of Columbia; Gilbert Grosvenor, Columbia Historical Society; L. Edwin Yocum, Botanical Society of Washington; William A. Dayton, Washington Section of the Society of American Foresters; Frank B. Scheetz, Washington Society of Engineers; Francis B. Silsbee, Washington Section of the American Institute of Electrical Engineers; Walter Ramberg, Washington Section of the American Society of Mechanical Engineers; Mario Mollari, Helminthological Society of Washington; Chester W. Emmons, Washington Branch of the Society of American Bacteriologists; Clement L. Garner, Washington Post of the Society of American Military Engineers; Herbert Grove Dorsey, Washington Section of the Institute of Radio Engineers; Owen B. French, Washington Section of the American Society of Civil Engineers. The elected members of the Board of Managers for a term of three years are Max A. McCall and Waldo L. Schmitt.

International News

Dr. Ross G. Harrison, Sterling professor of biology, emeritus, Yale University, and chairman of the National Research Council, has been elected foreign associate of the Académie de Médecine, Paris.

Dr. Bernard E. Read returned in March to Shanghai to take up his duties as the newly appointed director of the Henry Lester Institute of Medical Research, 1318 Avenue Road, Shanghai. In spite of the war, the library of this Institute is intact but now lacking the American journals published since December 1941. The Institute would appreciate gifts of these journals or of any other medical publications made during the war years.

Dr. E. A. Kreiken, one of the Netherlands astronomers on Java, has written recently to Dr. Bart J. Bok giving further details about the suffering of Indonesia. A recent issue of *Science* (1945, **102**, 642) announced that Dr. Aernout de Sitter, director of the Bosscha Observatory at Lembang, and Dr. Chr. W. Martin had died in Japanese prison camps, and that Mr. J. Utterdijk was lost in the sinking of a transport. This is confirmed by Dr. Kreiken, who adds that Dr. G. V. Simonow and Mr. Witlox, both of the Bosscha Observatory, have also died in captivity. The only two survivors of the seven Dutch astronomers on Java are the former director of the Bosscha Observatory, Dr. J. G. E. G. Voûte, and Dr. Kreiken.

Dr. Kreiken states that the Bosscha Observatory lies beyond the narrow, so-called "protected" zone around Bandoeng. It has been impossible for him to obtain information about its condition, but he is not hopeful. Dr. Kreiken's own library was totally destroyed when his house in Soerabaja was burned.

Dr. H. L. Booij, Laboratory of Medical Chemistry, Leyden (Willem Warnaarlaan 9, Sassenheim, Nederland), is greatly interested in all papers concerning applications of physical chemistry in biology and medicine. He has available some reprints of his papers for exchange.

Dr. Ferdinand Schoofs, professor of pharmacy at the School of Pharmacy, University of Liège, Belgium, who spent some time at Yale in 1927, writes to Clifford S. Leonard, of the University of Vermont, as follows:

> The University of Liège remained open all the time of the war, but our laboratories were working in very bad conditions: want of coal, of gas, of light (blackout), of chemicals, and even of distilled water. The students had to bring with them every day a liter of distilled water bought at a high price in the town.
>
> During the bombardment by the allied forces (accepted with the hope of approaching liberation) and later on during the period of robots (V-1 and V-2) thrown by the Germans, we passed several dangerous hours in the shelters. During the months of December 1944 and January–February 1945 I was living and sleeping in the cellar of my home; I received there several students for their examinations. But this dangerous period is now over and we try to forget it; but what we shall never forget are the cruelties of the Teutons.
>
> We are thankful to the allied forces and especially to the Americans, our liberators. Indeed the Americans delivered Liège in September 1944. On this occasion I met here several American professors, for instance Col. Gates of Ann Arbor. I received several times at my home a young and sympathetic assistant professor, Capt. Gordon of Columbia University; he kindly accepted my request that he lecture to my students concerning research on the estimation of alcohol in the blood.
>
> I have been very busy the last years, but now I attain the age limit (70 years); from the beginning of 1946 I am emeritus, legally obliged to rest, but feeling myself still healthy, I shall try to keep on working as long as possible, but no more doing any compulsory work. . . .

Dr. Pitirim A. Sorokin, professor of sociology at Harvard University, has been elected a foreign member of the Royal Academy of Science of Belgium in the class of the political and moral sciences. The honor was granted at a recent meeting. Dr. Sorokin is a native of Russia, where he was a member of the faculty of the University of St. Petersburg, and has been at Harvard since 1930.

Prof. Dr. M. Minnaert, director of the Observatory, Utrecht, Holland, in a letter dated 26 November 1945 to Dr. A. H. Rosenthal, of the Scophony Corporation of America, tells of his being in a hostage camp near s'Hertogenbosch from 1942 to 1944 and of the difficulties encountered in obtaining food during the winter of 1944–45. In March 1945, the Germans invaded the observatory, removing everything from the workshop and emptying nearly all of the buildings. They did not take away instruments or books, nor did they have time to destroy the machines. At present there are three times as many students as normally, but there is a lack of books and instruments; these cannot be purchased abroad because Holland cannot make available any foreign exchange for this purpose. Just before the start of the war the *Photometrical atlas of the solar spectrum* was published. Further, Dr. Houtgast, working on the Fraunhofer lines, has shown that the displacement is noncoherent. Mr. H. C. Van de Hulst studied the light-scattering on small globules of some wave lengths extension, while Dr. Minnaert has executed the detail photometry of the moon according to the reciprocity law.

The 112th annual meeting of AAAS has come to a close. The meeting was held under great difficulties in the overcrowded city of St. Louis, but some 2,300 people were finally registered, and attendance at at least one of the evening lectures approximated 3,500.

The official business of the Association was finished at a meeting of the Council called for 4:00 P.M. on Friday, 29 March. Dr. J. B. Conant was in the chair, and approximately 35 Council members were present. Several reports were received from the Executive Committee, and the usual last-minute resolutions were introduced. It was announced that the next meeting is to be held in December at Boston.

The affair contained one item of more than general interest, because at the request of Dr. Arthur Compton, Dr. Conant outlined the new plan for international control of atomic energy which had been announced to the press the night before by the State Department through Secretary Byrnes. The report proposes a new method of energy control through the production of nonexplosive or denatured materials which would be the output of atomic energy plants in the various countries. At one stage in the process of manufacture, according to President Conant, the materials would be dangerously explosive, but it was felt that these materials could not be surreptitiously stored or diverted to the manufacture of high explosives without knowledge of the controlling authority. The basis of the new plan seems to hinge on the adequacy of the denatured materials which are to be the output of the plants. The denatured materials are practically irreversible into dangerous elements because complicated manufacturing plants and an enormous personnel would be required to accomplish this end.

The entire issue of *Science* for 26 April will be devoted to summarizing the scientific papers and reporting the business accomplished at the St. Louis meeting.

The International Council of Scientific Unions will meet in general assembly in London on 22–24 July 1946. Meanwhile its Executive Committee has held a meeting in London attended by representatives of most of the International Unions adhering to the Council. In welcoming the Committee at its opening session Dr. A. V. Hill, foreign secretary of the Royal Society, pointed out that science in its own interest must remain an international concern and that the future of civilization itself depends upon the close cooperation of scientific men throughout the world.

The heavy toll of recent years on those prominent in the field of international science was revealed by the list of members of the Committee who had died since its last meeting: Il Marchese Marconi and Baron Joji Sakurai, vice-presidents; Sir Arthur Eddington, president of the International Astronomical Union; Prof. Nicola Parravano, president of the International Union of Chemistry; Sir Albert Seward, president of the International Union of Biology; Dr. Philippson, general secretary of the International Union of Physics; and General Bourgeois, former vice-president, representing the International Union of Geography.

The President of the Council, Prof. C. Fabry, who has since died, had been compelled to resign on account of ill health, and Dr. H. R. Kruyt was elected vice-president in his place.

The Entomological Society of British Columbia held its Forty-fifth Annual Meeting at Lytton, B. C., on 23 February. The following officers were elected for 1946: A. W. Finlay, New Westminster, honorary president; G. R. Hopping, Vernon, president; M. H. Hatch, University of Washington, Seattle, vice-president (Coast); J. D. Gregson, Kamloops, vice-president (Interior); H. B. Leech, Vernon, secretary-treasurer; W. G. Mathers, Vernon, auditor; and H. Andison, Vernon; G. P. Holland, Kamloops; J. R. J. L. Jones, Cobble Hill; J. Marshall, Summerland; and G. T. Mockridge, Cloverdale, advisory board.

Oxford University has accepted a collection of books on ethnology from the library of the late Dr. R. R. Marett, and also a grant of 1,200 pounds from the British Empire Cancer Campaign for chemical researches in the Dyson Perrins Laboratory relating to carcinogenic hydrocarbons, oestrogenic agents, and a differential growth inhibitor, 500 pounds of the grant to be earmarked for the provision of a special apparatus, and the remainder for the provision of fees and laboratory expenses for two research assistants.

Gen. Georges Perrier, 74, died at his home in Paris in February 1946. For many years Gen. Perrier was General Secretary of the Association of Geodesy of the International Union of Geodesy and Geophysics. This work is now being carried on at the former address, 19 Rue Auber, Paris 9^e^, by P. Tardi, "Secrétaire Adjoint." Gen. Perrier was a member of the French Academy of Sciences. In the early years of the present century he was the leader of geodetic expeditions in South America, North Africa, Albania, and Syria.

In the Laboratory

A Vibrating Muller for the Preparation of Dispersions of Fine Pigments for Electron Microscopy[1]

Harold C. O'Brien, Jr.
St. Joseph Lead Company, Monaca, Pennsylvania

In the preparation of fine pigments for examination in the electron microscope it is often difficult to break apart the smaller aggregates of the material. Where it is desired to resolve the ultimate particles in the micrograph, a considerable amount of work must be exerted upon the pigment.

A small portion of pigment, oil, and plastic are generally placed upon a flat glass plate, and a hand muller is used to press and grind and thus disperse the powder in the matrix. From a solution of the mixture a thin film is cast upon water and forms a support for the included pigment particles (*1*). Some other aspects of the technique involving solvents and the wetting of pigments have been described (*2*).

In the mulling of fine-particle pigments such as carbon black the aggregates remain unbroken in the film between the muller and the glass plate.

A new mechanical vibrating muller (Fig. 1), greatly increases the work exerted upon such a pigment mixture. It consists of a 110-volt A.C. electromagnetic vibrator unit, to which is attached a hardened steel mulling head. The mulling head is very slightly convex so that more perfect contact with the glass plate is obtained. The vibration occurs in an arc with the mulling head shaft as its radius. A handle on the vibrator unit permits hand-mulling concurrent with the vibrating effect.

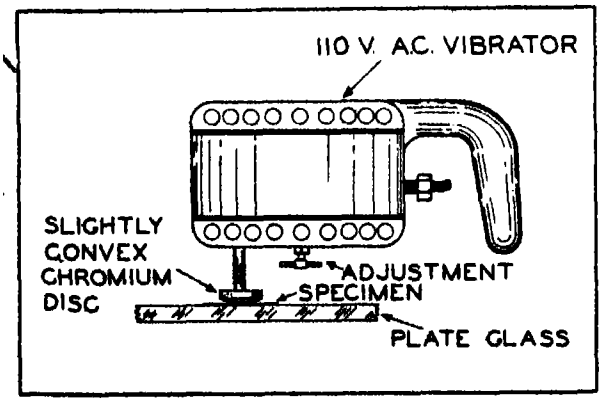


Fig. 1

The use of this device results in greatly increased work upon the pigment through direct contact and through the transfer of energy by vibrations in the matrix. By this method the time and effort required to disperse ultimate particles is substantially decreased.

References

1. Fuller, M. L., Brubaker, D. G., and Berger, R. W. *J. appl. Phys.*, 1944, **15**, 201.
2. O'Brien, H. C. *J. appl. Phys.*, 1945, **16**, 370.

A Note on the Silencing of Air-stirring Motors

W. H. Eberhardt
California Institute of Technology, Pasadena

Air-stirring motors are often viewed with disparagement in the laboratory because of the rather large amount of noise which attends their use. This noise may be traced to four sources: (1) that arising from the turbulent discharge of air from the compressed air lines into tubing connecting with the motor; (2) that due to air rushing through the pipes and the connecting tubing; (3) that inherent in the use of an air motor, *i.e.* bearing noise and the clear tone of audio-frequency which is associated with all turbines; and (4) that resulting from the air rushing out of the small escape ports generally provided in the flat surface on top of the motor. Of these sources, the first and fourth are by far the most important because of both the intensity and the raucous character of the noise arising from them. The devices suggested here have been found very useful in reducing to a very large extent the noise from these two sources. The second and third sources enumerated are of smaller importance, but their contribution to the total noise may be minimized by suitable choice of connective tubing and by judicious oiling.

The noise associated with the discharge of air through a regulating valve from the compressed air lines into the connecting tubing may be reduced greatly if the air flow is controlled not by this valve, but rather by a screw clamp operating on the tubing a few inches from its junction with the air line. If the air is supplied at high pressure, it will probably be found necessary to wire the tubing onto the outlet.

---

[1] Acknowledgment is made of the helpful cooperation of the Buhl Foundation Research Project, University of Pittsburgh.

It is thought that the procedure suggested here is effective because the turbulence resulting from the discharge of air under a high-pressure gradient at a sharp corner is eliminated and replaced by laminar flow past the constriction caused by the screw clamp.

The source of sound waves in connection with air discharged through the escape ports is undoubtedly the sharp edges of these ports. If the edges could be rounded and their radius of curvature increased, the noise would probably be reduced greatly. However, such a process is not generally desirable because it effectively requires reconstruction of the motor. The same end may be accomplished by clamping over the motor a small glass funnel, the diameter of which is less than that of the top of the motor but is sufficiently large to permit the funnel to cover the escape ports. The 2½-in. funnels generally available in chemical laboratories have about the correct diameter so that they fit readily over the top of the motor and may be held in place by many simple devices. The length of the stem is not critical; a very short stem seems to be as satisfactory as a long stem and is certainly much less in the way. The device presumably depends in its operation upon minimizing the relaxation oscillations from the escape ports, deadening the sound resulting from the oscillations which remain, and avoiding further oscillations by discharging the air at a smaller rate and in a state more nearly approaching laminar flow. Little or no effect upon the efficiency of the motor has been observed.

Letters to the Editor

Safeguarding Science in the NSF

The great interest of scientists in the various bills proposed to support scientific research is amply reflected in the continuing articles in *Science*.

It seems to me that scientists must not lose sight of the fundamental values in such appropriations. They will be valuable directly in proportion as they are valuable for research that is genuinely an effort to seek after the truth. They will become less valuable, and may even become a menace, if they are not protected at the outset so that the unvarnished truth may be sought after and properly published in the scientific journals now available for that purpose.

The history of all federal appropriations for educational research must be carefully scrutinized. There have been instances where funds for such purposes have been deliberately utilized for the production of propaganda to support the program of a given bureau or of a bureaucrat. Such utilization of funds will be condemned by all true scientists wherever they are.

One of the questions seems to be whether or not it is not better to obtain the money first and set up the safeguards afterward, and the rather competent statement is made that there is a certain amount of politics in connection with all funds available, whether it be within the great privately controlled research institutions or whether it be in public-supported research institutions. However, it is my opinion that it is very much better at the outset to put up every available safeguard, even at the risk of losing the appropriation, than it is to attempt to set up these safeguards after the bill or bills are written and entrenched interests established.

One has only to look at the ludicrous findings of the so-called "fact-finding boards" in instances already reported to know that no mathematical genius could ever have found the facts reported in the time that was available, coming out with figures that were identical for diverse industries. The layman can only look at the figures and say the fact finders were told what to find. The same sort of figures have been reported in the press in regard to what constitutes a sustaining diet for our people, and then the figures and results reported indicated that a large portion of the American citizens could not obtain a sufficient diet. An actual examination of the basis for the figures indicated rather clearly that a very large portion of our citizens had bad eating habits, but such a conclusion did not support the purpose of the interested bureaucrats. It must be evident to all scientists that this sort of thing is a waste of public funds and would become undesirable from the standpoint of scientists themselves.

M. W. WELCH

1515 Sedgwick Street, Chicago

On the New Kilgore-Magnuson Bill—S. 1850

The new Kilgore-Magnuson Bill (S. 1850) inevitably is disappointing to anyone who believes in the efficacy of the democratic tradition as accepted in this country. It concentrates power in the hands of too few persons. It does not derive its authority from the "scientific people," great and small. Its great defect is the ease with which it can lead to regimentation. The Administrator provided in this new bill, together with the Board, appointed by the President, and the Committees which the Administrator appoints, will be exercising power without the consent of the governed. These are the men and women who actually do the work and who alone are sufficiently close to the thinking which underlies scientific advance. No good can come from excluding them from the operation of a scientific organization. This bill attempts to legislate into existence a profoundly disturbing set of administrative devices.

A bill, in order to be acceptable, should contain as a minimum, the following provisions:

A *Constituent Assembly* should be called by the President, consisting of representatives, selected by the President, from the various forms of institutions of learning, colleges and universities, research institutes, industrial laboratories, and government services, lay and military, existing throughout the country.

Recommendations to the President should issue from the deliberations of this Assembly and its appropriate functional committees, including primarily nominations to a responsible Board of Directors.

The *Board of Directors* should be appointed by the President from among the nominees, with the consent and advice of the Senate. This Board should have the powers usually exercised by such Boards in nonprofit membership corporations. The Members of this Board should devote as much time to the Corporation as may be necessary to its proper functioning and the carrying out of its objectives. The Board should formulate its own rules of procedure. The Board should be responsible at all times to the "Scientific People," represented in an Assembly of Members, which should succeed to the authority of the Constituent Assembly.

The *functions of the Board should include*:

(1) Carrying out the policies of the Corporation.

(2) Recommending to the President, for his choice, candidates to serve as Administrator. The Administrator should be responsible to the Board and see to carrying out the purposes of the Corporation.

(3) Appointing the Members of the Scientific Committees, on the advice of the Administrator, the Committees appointing their own Chairmen.

(4) Making appropriations and grants and appointing fellows and scholars on the recommendation of the Scientific Committees, and in accordance with regulations made by the Board, with the advice of the Scientific Committees.

ALFRED E. COHN, *Member Emeritus*
Rockefeller Institute for Medical Research

The Amino Acid Composition of Proteins and Foods

H. B. Vickery and H. T. Clarke (*Science*, 1945, 102, 454–456) have questioned the practice of computing the results of amino acid determinations upon a uniform basis as employed in our monograph (*The amino acid composition of proteins and foods*. Springfield, Ill.: C. C. Thomas, 1945).

Four or five years ago, when contemplating the writing of this monograph, the various methods for presenting amino acid data were discussed with a number of workers in the protein field. The easiest method, from the authors' point of view, would have been to copy the data in the literature and to present the figures as per cents by weight of substance analyzed in some cases, as amino acid nitrogen in per cent of total nitrogen in others, or as per cent by weight corrected for "moisture" and "ash" in others, etc. A second method would have been to calculate all the data as amino acid nitrogen in per cent of total N. Although this procedure is useful for many purposes, we did not consider it as suitable for a monograph designed primarily for food chemists. A third method, used by Murrill, *et al.* (*J. biol. Chem.*, 1940, 133, 521), appeared to be most suitable for our objectives.

How intelligible would the first procedure be to the average person whom we believed would use this monograph? It would impose a considerable burden on those who wished to compare the results by a number of investigators on the same protein. For example, amino acid values of casein may be given by one investigator as per cent of a sample of commercial casein as analyzed ($N = 13.6$ per cent); by another, as per cent of the casein corrected for "moisture" and "ash" ($N = 14.9$ per cent); a third author may hydrolyze a sample of casein and then calculate the quantity of "pure" casein used from a nitrogen determination on the hydrolysate, taking 15.7 as the per cent of nitrogen in casein; etc.

In order to facilitate comparison of analytical data on the same protein by different investigators, we chose an extension of the third method of presentation, namely, calculation of all values to 16 per cent of N. In an attempt to prevent any misunderstanding of our purpose, the original nitrogen values upon which the calculations rested are presented in all except a very few instances, and even in these cases the reasons are explained in the text. Furthermore, repeated examples of how the data in the tables are to be used are given. For instance, on pages x and xi of the Introduction we say: "As all the data in the tables are calculated on the basis of 16 percent of nitrogen, it is only necessary to know the nitrogen content of the protein in order to calculate the data in the tables to give the approximate amino acid composition of the preparation. If the protein contains 18.6 percent of nitrogen on a moisture and ash free basis, then the values in the proper table are multiplied by the factor $\frac{18.6}{16.0} = 1.16$." Other examples are also given here and throughout.

This type of presentation was repeatedly tested before publication by presenting papers containing these calculations at protein symposia such as the American Chemical Society at Cleveland, the Cereal Chemists Meeting at Minneapolis, the Gibson Island Conferences, and a half dozen other meetings and seminars, as well as by the distribution of much of the data to government agencies and groups interested in food chemistry. At no time was any adverse criticism made of the manner of presentation.

Our monograph was designed primarily to present to the food chemist the widely scattered literature on the methods and results of protein analysis in the most useful and practical form. We have sincere doubts concerning the advisability of presenting original data only in this type of monograph. While, if each table had been devised on the basis of a currently accepted value of nitrogen of a pure protein, then it would have been incumbent on the food chemist to make the conversion to the factor he was using for estimating the protein content of the diet. The factor is almost always 6.25. We felt that the protein chemist was equally prepared to perform the reverse calculation. It is quite true that many arguments against this practice may be presented, including those stated many years ago by Kossel, the venerable nature of whose views does not necessarily impart increasing force. The fact remains that "N × 6.25" is not only almost universal, but it is incorporated into the food and feed laws of almost every state in the Union. Almquist (Nutritional Conference, Oregon State College, March 1945) said in this connection: "While it has been shown that this conversion factor differs from 6.25 for certain single foodstuffs, the fact that they are ultimately mixed and accounted for in prepared feeds on the basis of a 6.25 protein factor is ample justification for retaining this factor."

Although we used the N × 6.25 calculation in this monograph, we repeatedly mentioned its limitations and certainly did not advocate it as a general practice in protein chemistry. In fact, in two tables on the amino acid composition of selected plant and animal proteins, prepared by one of us for a recent textbook (Kleiner's *Human biochemistry*. St. Louis: C. V. Mosby, 1945), only the industrially important corn gluten, wheat gluten, soybean proteins, and yeast proteins are calculated to 16.0 per cent of nitrogen. The remaining 14 proteins, being considered purified products, are given on the basis of the best available nitrogen values.

Thus, the so-called calculation error is nullified when the amino acid values are employed in the manner which we designated. However, because the amino acid data could be misconstrued, in spite of the precautions taken, we contemplate presenting the data in the forthcoming revision of this monograph as grams of amino acids per 16 grams of nitrogen in the sample. It is hardly necessary to point out that the actual values given and the mode of calculation to purified proteins or crude foodstuffs remains unchanged.

R. J. Block

New York Medical College
Flower and Fifth Avenue Hospitals, New York City

D. Bolling

Cooper Road, Scarsdale, New York

Amino Acids in Food Materials

R. J. Block and D. Bolling's recent publication (*The amino acid composition of proteins and foods*. Springfield, Ill.: Charles C. Thomas, 1945) contains 14 tables presenting the amino acid content of a variety of "pure" and mixed proteins from animal and plant sources. The percentage of amino acids in these proteins is uniformly calculated from an assumed 16 per cent of nitrogen in each protein. Of course, the usual procedure was followed of determining the nitrogen in the material to be examined and then multiplying by 6.25 for conversion to protein.

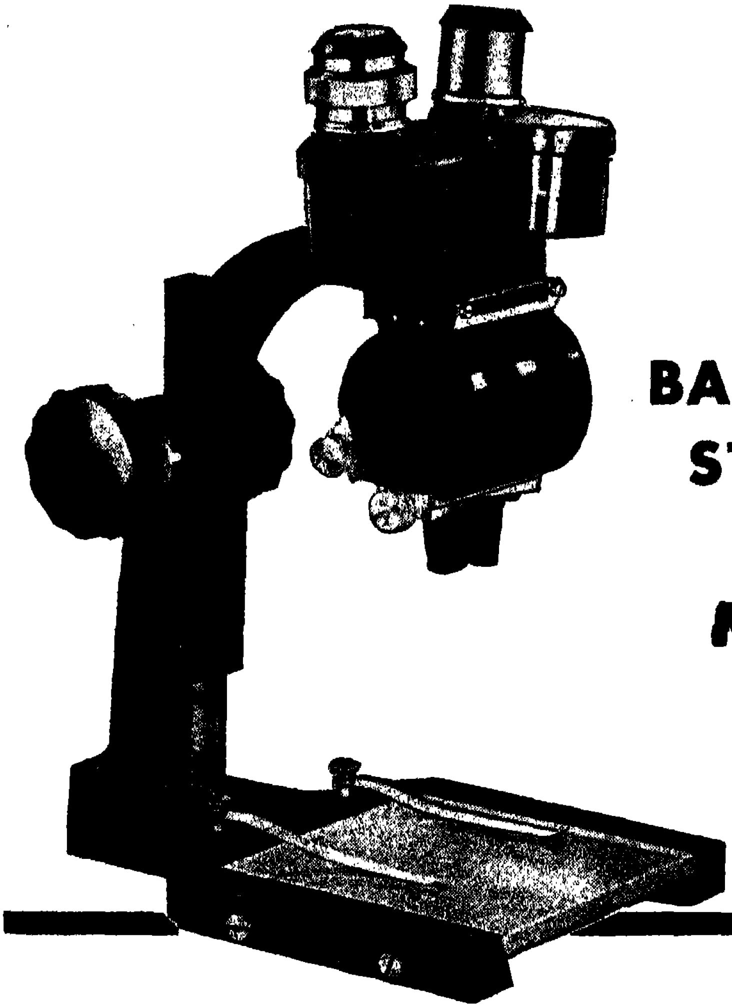
This procedure of stating the amino acid content of the protein has recently been sharply criticized by H. B. Vickery and H. T. Clarke (*Science*, 1945, 102, 454–456). They argue that since the nitrogen conversion factor for casein, edestin, and a very limited number of proteins is known, such factors should have been used and not a uniform factor based on 16 per cent of the nitrogen in the protein. Surely they are correct in insisting that the nitrogen-to-protein conversion factor, when definitely known, should be used. But, how many proteins, with known nitrogen content, have been isolated in a sufficiently pure state to make possible the erection of extensive tables on the amino acid content of proteins or foods? Not many, as compared with the number of foods and feeds.

In nutrition we are interested in the amino acid distribution in the foodstuff itself, such as wheat, meat, milk, eggs, etc., and not in the amino acid content of a single protein constituent of the foodstuff, except for fundamental studies in protein chemistry.

Consequently, Block and Bolling could do little else than follow the method they used, especially since they included in the tables such complex protein mixtures as tankage, meat scraps, fish meal, feathers, liver, grass, yeast, oats, linseed meal, etc. There are no accurate or even proposed conversion factors for such complex protein mixtures.

Historically, Armsby once proposed the term "true protein" of feeding materials for the basis of determining the protein requirement of animals. He did this because it was known that there existed in plant materials considerable unorganized nitrogen, assumed to be of non-nutritive value. The Agricultural Chemist measured the "true protein" of a feeding material, by the use of Stutzer's reagent, a copper compound supposedly effective as a precipitant of all protein nitrogen. Such a procedure is no longer followed. Yet, if one converts the nitrogen of an alfalfa hay to protein by the use of the conventional factor of 6.25, he must realize the gross error involved. There is no conversion factor for nitrogen to protein in food materials that is at all uniformly or even approximately reliable.

With this situation, what can be done? Adopt the plan of expressing the amino acids of a food or a feed material as per cent (1) of the dry material or (2) of the dry, fat-free material. We do this today for many constituents such as calcium, magnesium, etc. No attempt is made to express such constituents as per cent of the ash or of the complexes in which they exist. Use the weight of the free amino acid and not the anhydride. When the amino acid content of a food is expressed on the dry basis, it would be desirable to have the analysis accompanied by the amount of fat in the sample, especially for those products such as meat, where the fat content is extremely variable. These are the preferred methods. Or, (3) express the amino acids of a food or a feedstuff as per cent of the total nitrogen either



BAUSCH & LOMB STEREOSCOPIC WIDE FIELD MICROSCOPE

MODEL AKW

This is the ideal instrument for dissection, preliminary study, and for examinations that do not require high magnification. The long working distance, the fact that the object is seen as it really is—not inverted or reversed—and the stereoscopic effect, make this instrument invaluable. It may be placed directly upon a gross specimen when desired. Clear glass stage 100 x 100 mm. supplied. Characteristics of this microscope also include an extremely wide field, high eyepoint, and instantly variable magnification with parfocal objectives. Write for Catalog D-15. Bausch & Lomb Optical Co., 642-4 St. Paul Street, Rochester 2, N. Y.

BAUSCH & LOMB

ESTABLISHED 1853

on a fat and water-free basis or as the material occurs. Again use the weight of the free amino acid and not its anhydride. This procedure is in part a reversion to the elemental system so far as nitrogen is concerned, such as is now used for calcium, magnesium, potassium, phosphorus, etc., in food materials.

At one time most of these elements were expressed as the oxides such as K_2O (potash) for potassium and P_2O_5 (phosphoric acid) for phosphorus. The "oxide system" is still in vogue in the fertilizer industry except for trace elements and nitrogen. But surely the adoption of the elemental system for foodstuffs was a progressive step.

Such a procedure as is proposed under (3) still lacks absolute accuracy due to the fact that not all of the nitrogen of a food material is of known nutritive value. But the method is not clouded with hypothetical conversion factors.

E. B. Hart

Department of Biochemistry, University of Wisconsin

Book Reviews

One world or none: a report to the public on the full meaning of the atomic bomb. Dexter Masters and Katherine Way. (Eds.) New York: Whittlesey House, McGraw-Hill, 1946. Pp. x + 79. (Illustrated.) $1.00.

Since the publication of the Smyth report this book is perhaps the most significant which has appeared on the subject of the atomic bomb. It is a collection of skillfully edited articles written by the men who laid the scientific foundations on which the bomb was constructed; by the men who built the bomb; by those who were the official War Department inspectors of the destruction wrought by the bomb; by those who realize its implications for the world—in short, it is written *by those who know about the bomb.* Those of us who wish to live out our years in this world, who want some assurance that our children will also live out their years, can do no less than to listen to these men and ponder the message they carry.

Who are the authors of this significant book? Niels Bohr, A. H. Compton, H. H. Arnold, Hans Bethe, E. U. Condon, Albert Einstein, Irving Langmuir, Walter Lippmann, Philip Morrison, J. R. Oppenheimer, Louis Ridenour, Frederick Seitz, Harlow Shapley, Leo Szilard, Harold Urey, Eugene P. Wigner, Gale Young, and the Federation of American Scientists. *They are the men who know.*

What do they tell us, *these men who know?* Philip Morrison, one of the official War Department inspectors begins the book by giving a grim picture of the damage done at Hiroshima, and he speculates on the basis of observed facts about the damage a similar bomb might do in New York. Harlow Shapley, Harvard astronomer, next proceeds to discuss atomic energy as it operates in the sun and stars, thus providing a basis for understanding man's efforts to release this energy on earth. E. P. Wigner discusses the roots of atomic energy, explaining what atomic energy is and how it operates in a bomb, and Gale Young tells about the industrial possibilities of atomic energy. J. R. Oppenheimer, the man who directed the actual building of the bomb writes about it as "the new weapon" and points out that "the release of atomic energy constitutes a force too revolutionary to consider in the framework of old ideas." Gen. H. H. Arnold, former chief of the Army Air Forces, presents a sobering picture of air power in any future war. His chapter is followed by what the present reviewer believes to be one of the most important sections in the book. It is by Louis Ridenour and is entitled: "There is no defense." As a member of the famous Radiation Laboratory of the Massachusetts Institute of Technology, he is perhaps best equipped to discuss the problem of defense against an atomic bomb. After reviewing the facts, his conclusion is brief and to the point: THERE IS NO DEFENSE. E. U. Condon continues in a chapter on "The New Technique of Private War" by outlining the increased possibilities opened to the saboteur and the agent provocateur. If the reader raises a skeptical eyebrow, he is reminded that the authors of this book are serious scientists and not writers of scientific fiction.

Frederick Seitz and Hans Bethe attempt an estimate of how close is the danger of atomic warfare and warn that it is much closer than we dream. Irving Langmuir lucidly outlines the stages in an atomic arms race and the alternatives to such a race. He points out that we can, and must, find a basis for amicable living with Russia and is in favor of stopping the production of atomic bombs and dismantling the plants which produce them if these steps will insure peace.

Harold Urey assumes the mantle of Jeremiah when he asks the question (and it is far from a rhetorical one): "How Does It All Add Up?" He concludes that "it all adds up to the most dangerous situation that humanity has ever faced in all history." Leo Szilard raises the problem of whether an atomic arms race can be averted by an inspection system, and Walter Lippmann examines the question of the international control of atomic energy. Albert Einstein points a way out—a way he feels is the only course, that of vesting military power in a world state. Finally, the Federation of American Scientists, in a summary of the issues, warns that survival is at stake and issues a clarion call to action.

Yes, survival is at stake—not merely personal and individual survival but the survival of our nation, of other nations, and of civilization itself.

The facts assembled in this book provide a vision of what atomic energy can do in a world which uses it for constructive and peaceful purposes. But these same facts point to the inescapable conclusion that while "the nations of the world can have atomic energy and much more, they cannot have it in a world where war may come."

MORRIS C. LEIKIND
Library of Congress, Washington, D. C.

The Royal Society 1660–1940: a history of its administration under its charters. Sir Henry Lyons, F.R.S. Cambridge: At the Univ. Press; New York: Macmillan, 1944. Pp. x + 354. (Out of print.)

As the late Sir Henry Lyons has stated in his Introduction, this is not the complete history of the Royal Society: "This account of the way in which the Society carried on its business at different periods will provide the groundwork for a fuller discussion of its influence on the advancement of science; it also records the conditions under which the more eminent of its Fellows carried out their researches and discoveries. The complete history of the Society has not yet been undertaken, and it may well require the united efforts of several workers to deal with so wide a field of activity."

Nevertheless, this book contains a surprising amount of information about the origin of the Society and the 280 years of science in England since its establishment. Many interesting sidelights of scientific history are interspersed between the discussions of the financial problems and administrative organization of the Society which are its principal concern. It is amusing to learn, for example, that the Royal Society was accused of taking sides with the American colonists during the Revolution because it advocated the use of Benjamin Franklin's pointed lightning rods, and that the King himself tried to persuade the Society to rescind its resolution.

Although the original founders of the Royal Society were mostly scientists who met for the purpose of critically examining new discoveries and theories, the scientific purpose of the Society was often lost sight of, and scientists were actually in the minority until 1860. Even Samuel Pepys was president (a good one, to be sure) during the two years when Newton's *Principia* was being published. Incidentally, it was Sir Isaac Newton, first man of science to be knighted, who was responsible for the fact that the Royal Society now meets on Thursdays, since he was occupied at the mint on Wednesdays (the Society's original meeting day) during the first years of his presidency. Despite the presidencies of such well-known men of science as Newton and Sir Joseph Banks, the Royal Society was more of a cultural than a scientific institution until the middle of the Nineteenth Century. Since 1860, however, the Society has become the leader of scientific thought in Great Britain and a unique institution in the world of science. Like all venerable institutions, it is sometimes slow to

HOEBER BOOKS

the mind body field

Dunbar's

PSYCHOSOMATIC DIAGNOSIS

Pioneer work pushing back the frontiers of medicine . . . indicating the relation of psyche and soma in the most important disease syndromes. Flanders Dunbar's clear, well-organized volume, result of a 12-year study at Columbia, is fascinating reading as well as a long-time useful reference.

3rd printing, 760 pp., $7.50

Gantt's

EXPERIMENTAL BASIS FOR NEUROTIC BEHAVIOR

This unique new study by W. Horsley Gantt of Johns Hopkins reports on a painstaking original experiment — demonstrating *and measuring* emotional, conflict-induced, disorders and neuroses in dogs. Basic, significant material on experimental psychology.

227 pp., illus., $4.50

Gesell & Amatruda's

DEVELOPMENTAL DIAGNOSIS

In this eminently readable, abundantly illustrated volume is offered the practical fruit of thirty-five years of basic research in child development at the famous Yale Clinic. The normal pattern of child behavior growth, normal deviations, and abnormal mental development are clearly described in clinical detail.

460 pp., 116 illus., $6.50

SCI. 5/46

PAUL B. HOEBER, INC., *Publishers*
Medical Book Dept. of Harper & Brothers
49 E. 33rd Street, New York 16, N. Y.

Please send me: ....

☐ On approval ☐ Charge ☐ Check encl.

Name .... Address ....

change, and it is something of a shock to learn that the uncomfortable benches in use for generations were not replaced until 1939, when "others of modern type more suitable for meetings which lasted long and demanded the close attention of the audience" were installed.

As treasurer of the Royal Society for many years, Sir Henry Lyons had access to its records and was well qualified to write its administrative history. The great wealth of information in this book concerning the finances and administration of the Royal Society make it particularly useful to specialists in the history of science. Inasmuch as there has been no comprehensive history of the Society for a hundred years, the book should also be of interest to those who are not specialists for it is much more than a treasurer's report. Each chapter has a useful short bibliography and there is an excellent index. It is to be regretted that this book was published in such a small edition that it is already out of print.

Joel W. Hedgpeth

Game, Fish and Oyster Commission
Rockport, Texas

B-Chloroethyl Amines and Sulfides

(Continued from p. 415.)

References[1]

1. Krumbhaar, E. B., and Krumbhaar, H. D. *J. med. Res.*, 1919, 40, 497.
2. Pappenheimer, A. M., and Vance, M. *J. exp. Med.*, 1920, 31, 71.
3. Flury, F., and Wieland, H. *Z. ges. exp. Med.*, 1921, 13, 367.
4. Warthin, A. S., and Weller, C. B. *The medical aspects of mustard gas poisoning.* St. Louis: C. V. Mosby, 1919.
5. Lynch, V., Smith, H. W., and Marshall, E. K. *J. Pharm. exp. Therap.*, 1918, 12, 265.
6. Muntsch, O. *Klin. Wschr.*, 1934, 13, 482, 529.
7. Maier, G. *Z. ges. exp. Med.*, 1938, 103, 458.
8. Drews, M. *Z. ges. exp. Med.*, 1939, 105, 29.
9. Berenblum, I. *J. Path. Bact.*, 1935, 40, 549.
10. Freundlich, H., *et al.* *Z. phys. Chem.*, 1911, 76, 79; 1912, 79, 681; 1922, 101, 177; 1926, 122, 39; 1933, 166A, 161.
11. Solomon, G. *Trans. Faraday Soc.*, 1936, 32, 153.
12. Marvel, C. S., *et al.* *J. Amer. chem. Ass.*, 1936, 58, 2277. (Sixth of a series dealing with halogenated tertiary amines.)
13. Ball, E. G., Buchanan, J. M., Doering, W. E., Marston, E. L., McKee, R. W., and Ormsbee, R. A., 1942–43.
14. Bartlett, F. D., Swain, C. G., Ross, S. D., and Davis, J. W., 1942–45.
15. Bergmann, M., Fruton, J. S., Golumbic, C., Irving, G. W., Moore, S., Stahmann, M. A., and Stein, W. H., 1942–45.
16. Cohen, B., Harris, J., Van Artsdalen, E. R., and Perkins, M. E., 1943–45.
17. Northrop, J. H., Herriott, R. M., and Anson, M. L., 1943–44.
*18. Ogston, A. G., Holiday, E. R., Powell, E. W., Philpot, J. St. L., and Stocken, L., 1941–44.
*19. Rydon, H. N., Hartley, G. S., *et al.*, 1942–43.
20. DuVigneaud, V., Carpenter, F. H., McDuffie, H. F., Jr., McKennis, H., Jr., Melville, D. B., Rachele, R., Stevens, C. M., and Wood, J. L., 1942–44.
*21. Winkler, C. A., Thompson, A. L., and Hardwick, T. J., 1942–43.
*22. Wormal, A., *et al.*, 1941–44.
23. Lushbaugh, C. C., 1942–45.
24. Kethley, T. W., Marquand, C. B., McElroy, C. E., McNamara, B. P., and Neville, G. H., 1942.
*25. Cameron, G. R., Rydon, H. N., *et al.*, 1942–43.
26. Smith, H. W., *et al.*, 1942–45.
27. Karnofsky, D., Graef, I., and Addis, E., 1942–43.
28. Gilman, A., Goodman, L., Philips, F. S., and Allen, R. P., 1942–43.
29. Salter, W. T., and Bass, A., 1942–43.
*30. Courtice, F. C., *et al.*, 1943–44.
31. Dougherty, T., *et al.*, 1943.
32. Jager, V., Wintrobe, M. M., Ginzler, A. M., and Gordon, S. M., 1943.
33. Alexander, S. F., 1943–44.
34. Jordon, H. E., and Kindred, H. E., 1945.
35. Houck, C. R., Crawford, B., and Smith, H. W., 1944.
*36. Gregory, R. A., and Smyth, D. H., 1944.
37. Philips, F. S., Koelle, E. S., McNamara, B. P., Allen, R. P., and Gilman, A., 1944.
*38. Cordier, D. G., 1941–45.
39. Berenblum, I., Kendall, L. P., and Orr, J. W. *J. Biochem.*, 1936, 30, 709.
*40. Thompson, R. H. S., 1940.
*41. Dixon, M., Needham, D. M., van Heyningen, R., *et al.*, 1940–44.
*42. Peters, R. A., Wakelin, R. W., *et al.*, 1940–44.
43. Barron, E. S. G., Bartlett, G., Mayer, J., Miller, Z. B., and Presta, U. A., 1942–45.
44. Cogan, D. G., Kinsey, V. E., Grant, W. M., Pentz, H., and Robinson, P., 1943–45.
45. Friedenwald, J., Hermann, H., Hickman, F., and Scholz, R. O., 1943–45.
46. Rhoads, C. P., Warren, C., and MacLeod, J., 1942–43.
47. Peters, R. A. *Nature, Lond.*, 1936, 138, 327.
*48. Peters, R. A., Berenblum, I., Holiday, E. R., Ogston, A. G., Philpot, J. St. L., and Walker, E., 1941.
49. Cori, C. F., Colowick, S. P., Berger, L., and Slein, M. W., 1942–45.
50. Northrop, J. H., Kunitz, M., Herriott, R. M., and McDonald, M. R., 1943.
51. Kinsey, V. E., and Grant, W. M., 1943.
52. Cannan, R. K., Levy, M., Benaglia, A., and Harvey, E. B., 1943–44.
53. Bodenstein, D., and Gillette, R., 1945.
54. Friedenwald, J. S., and Scholz, R. O., 1943.
55. Marchak, A., reported by Smith, H. W., 1943.
56. Friedenwald, J. S., 1945.
*57. Koller, P. C., Ansari, M. Y., and Robson, J. M., 1943.
*58. Auerbach, C., Ansari, M. Y., and Robson, J. M., 1942–43.
*59. Bawden, F. C., and Pirie, N. W., 1944.
60. Cannan, R. K., Levy, M., Benaglia, A., and Vislocky, K., 1943–44.
61. Osterhout, W. J. V., 1942–44.
*62. Fell, H. B., and Allsopp, C. B., 1942.
*63. Hancox, N. M., 1942.
64. Dougherty, T., Gilman, A., Goodman, L., and Dougherty, J., 1942–43.
65. Gilman, A., Goodman, L., Lindskog, G. E., and Dougherty, J., 1942–43.
66. Jacobson, L. O., Barron, E. S. G., Dick, G. F., Spurr, C. L., Smith, T., and Lushbaugh, C. C., 1943–45.
67. Goodman, L., Dameshek, W., Wintrobe, M. M., and Goodman, M., 1943–45.
68. Karnofski, D., Craver, L. F., and Abels, J. C., 1945–46.

---

[1] The majority of the references cited above are to classified documents which are not generally available. Reference is therefore made to authors and the time at which their work was conducted. Those references preceded by an asterisk refer to unpublished British work.

SCIENCE

Vol. 103, No. 2676 Friday, April 12, 1946

Advisory Committee on Scientific Personnel

M. H. Trytten, *Chairman*

THE EXTENT OF SCIENTIFIC RESEARCH under government administration is clearly to be greater in the postwar years than ever in history. The military departments alone will be faced with the need for large-scale activities if they are to keep pace with the unfolding of science. But also the other departments having scientific responsibilities will need to enhance the pace and scope of their activities. These facts have led government scientists to see the need to improve the employment status of Civil Service scientists by revised Civil Service rules and regulations affecting scientific employees, so that government service in this field may achieve a career potentiality on a par with any other type of scientific employment.

To attain this end, there has been established by the Civil Service Commission an Advisory Committee on Scientific Personnel. The recommendation for the establishment of the Committee was made by the Council of Personnel Administration, the official government policy-forming organization in personnel matters. The members of the new Advisory Committee were named in each case by the Secretary of the Federal department represented. The chairman was selected from a nongovernment agency to provide representation of the point of view of organized science.

The activities of the ACSP have been in two main areas. Important from the first was the need to facilitate in-service training for the rather large army (ca. 5,000–10,000) of Federal scientific and technical employees at the graduate level in the Washington area. This problem has involved canvasses to determine course needs and course offerings, and efforts to assist in solving educational problems associated with this work. These and attendant problems are being met by an auxiliary committee, the Science Training Group, under the chairmanship of Dr. M. W. White, Dr. Philip Powers, secretary.

The other major area of interest of the ACSP has been in the regulations under which the scientific Civil Service works. Here, too, an auxiliary committee has been set up and has been working to develop concrete recommendations which, after concurrence by the senior committee, are then taken up by the ACSP with the Civil Service Commission and others for discussion. The members of the auxiliary committee on Civil Service regulations are: Dr. A. H. Hausrath, Navy Department; Dr. K. E. Lohman, U. S. Geological Survey; Dr. W. H. Larrimer, Department of Agriculture; Dr. M. J. Shear, National Cancer Institute; Dr. F. G. Brickwedde, National Bureau of Standards; Dr. R. C. Duncan, Naval Ordnance Laboratory; and Lt. Col. T. H. Whitehead, Chemical Warfare Service.

Perhaps from time to time some discussion of particular recommendations may occur in the scientific periodicals. In view of the increasing role of scientists in the Government, there can be no doubt that all scientists have a stake in the matter. Some recommendations have already been made, and, in fact, the Executive Order of 16 February 1946, providing for return of Civil Service to a peacetime status, includes several provisions reflecting the thinking of the Committee. Other recommendations are now under consideration. The article which follows is deemed of interest to scientists generally as a by-product of the considerations of this Committee.

Members of the Advisory Committee on Scientific Personnel

M. H. Trytten, *Chairman*, Office of Scientific Personnel, National Research Council; Ralph D. Bennett, Capt., USNR, Naval Ordnance Laboratory; Edward U. Condon, National Bureau of Standards; R. E. Dyer, National Institute of Health (represented by L. F. Badger); Stanley B. Fracker, Agricultural Research Administration; Kenneth L. Heaton, Office of the Secretary of War; Thomas B. Nolan, U. S. Geological Survey. (Ross Pollock, Civil Service Commission, liaison.)

Need for a Meaningful B.S. Degree

Advisory Committee on Scientific Personnel

Scientific groups have been much disturbed by the official interpretation of the Starnes-Scrugham Act of 1944, the so-called "Veterans Preference Act." This Act provides that:

> No minimum educational requirements will be prescribed in any civil-service examination except for such *scientific, technical, or professional positions* the duties of which the Civil Service Commission decides cannot be *performed* by a person who does not have such education. The Commission shall make a part of its public records its reasons for such decisions.

Before the passage of this Act the Civil Service Commission had automatically prescribed a four-year college education or its equivalent as the basic educational requirement for examinations for probational appointment in the P-1 and P-2 grades in the professional and scientific services of the Government. The restrictions in this Act on the use of minimum educational requirements, therefore, appeared a clear-cut case of the reduction of standards in the Federal scientific Civil Service. Recently the sentiment among scientists against such apparent lowering of standards became so strong that the National Academy of Sciences and the National Research Council became interested in the problem, and letters signed by Dr. Frank B. Jewett for the Academy and Dr. Ross G. Harrison for the Council were written to many scientific societies. They suggested that the scientific societies consider the matter and express their opinions in formal communications to the government officials dealing with the subject. As a result, a great number of letters have come to the National Academy of Sciences and the National Research Council, expressing the deepest concern over this problem.

The Advisory Committee on Scientific Personnel has given much time to the consideration of the Veterans Preference Act as it bears upon the matter of educational requirements for Federal positions. It has discussed the matter with the CSC and with veterans' organizations. In all these discussions it has been recognized by everyone that it is to the best interest of neither the government service nor the veteran to place any but the most highly qualified persons in the scientific staff of the Federal Government. The only point at issue, therefore, has been the long-time effect of the given clause on the quality of the scientific Civil Service.

Perhaps the most important single point raised in the Congressional discussions preceding the passage of the Starnes-Scrugham Act was the reliability of the Bachelor of Science degree as a measure of academic accomplishment. It was pointed out frequently that the standard for the B.S. degree in American colleges and universities is a highly variable quantity. In some cases a stiff professional curriculum is required, while in others, work in the major subject is extremely limited and much of that work may, in fact, consist of courses in the teaching of the subject and may therefore yield little in professional training of the type required for scientific work in the Government. There is also considerable variability as to nature and number of collateral courses prescribed. If the B.S. degree is to be demanded as a requirement and strictly adhered to, it might result in such absurd cases, for example, as that where a near graduate of a highly technical institution with a large percentage of required courses in the field would be turned aside, while the holder of a degree from an institution which required only the weakest major could be accepted. The point made by the veterans' organizations and many in Congress was that a criterion such as the B.S. degree could be demanded with consistency only when it was, in itself, a consistent measure of accomplishment or when it at least could be depended upon as the best available guarantee of a minimum level of preparation.

The ACSP believes the situation to be highly unfortunate, because it seems quite clear that a first line of defense against dilution has been lost by the removal from Civil Service entrance provisions of the requirement of a B.S. degree. It is possible to retreat to a second line of defense, which would mean the setting up of particular credit requirements such as, for example, 30 credit hours in the major subject and strongly contributing minor subjects. The obvious disadvantages of such a requirement need hardly be emphasized. It may be pointed out, however, that if only the credit requirements in chemistry, for example, be stated (e.g. 30 credits) and, as is required by law, posted in public places throughout the land, this may well act as an incentive to candidates to confine their training to the base minimum of such courses without collateral courses. And if additional collateral courses in neighboring fields be specified, it may in the long run serve to set up the CSC as a curriculum influence of importance in American college practice. It would be better if curricula were established by departments in the interest of a sound training rather than in the interest of meeting some particular formula laid down by the CSC.

This problem might not be deemed so important if employment by the Federal Government were a minor factor in the whole scientific employment pattern. It is already a major factor in certain fields, and its importance may extend to other fields as time goes on. Furthermore, the problem of meaningful B.S. degrees extends far beyond the Civil Service. The weakness of this degree as a criterion has frequently been embarrassing throughout the war period. It was a big factor in the Selective Service situation. Had professional B.S. curricula existed, it is possible that the Selective Service System would have been able to use them as criteria of minimum preparation for use in screening out those who should be given special consideration as scientists, thus obviating some of the cases of flagrant misassignments of scientific personnel. In assigning Federal fellowships or Federal monies for students in the early part of the war, the lack of such a recognized curriculum, or at least of some recognized standard of minimum preparation in the fields of interest, was felt.

Discussions on the proper type of organization for the mobilization of scientific personnel in wartime have been numerous during the war and since V-J Day, many of these have taken place among military personnel. Perhaps some type of organization similar to the Medical Corps will arise in time. If so, scientists will need to be commissioned from civil life on the basis of accomplishment. Again, a meaningful B.S. degree is necessary.

The present National Research Foundation Bill, sponsored by Senators Magnuson, Kilgore, *et al.*, (S. 1850), calls for the establishment of fellowships for advanced study. The same problem of threshold preparation for applicants will arise, and the existence of a meaningful B.S. degree would again be useful. The dominant role of American scientific education in the world today will mean that foreign students will come here more and more and that our students will go abroad. The American degree will then become to a greater and greater extent world currency in this field. It would be better in this connection, too, if a more uniform measure of accomplishment were represented by our B.S. degree.

These are indications that the Federal Government is being called on more and more frequently to deal with persons on the basis of their academic accomplishments. The law and regulations based on the law require the existence of definable terms. The B.S. degree at the present time is frankly not a sharply definable term. The ACSP is not presuming to suggest any particular action, but does feel a responsibility to present to the scientific population a situation which seems worth describing and which does seem to merit most thoughtful consideration.

Canadian Researches on BAL (British Anti-Lewisite)

Leslie Young
Department of Biochemistry, University of Toronto

ONE OF THE OUTSTANDING ACHIEVEMENTS in the field of chemical warfare research in World War II was the discovery by Peters, Stocken, and Thompson of the antidotal action of 2,3-dimercapto-propanol (BAL, British antilewisite) to lewisite and other arsenical compounds. Two reviews of work on BAL have been published recently. The first of these was by Peters, Stocken, and Thompson (*3*), and the second, which dealt particularly with researches on BAL in the United States, was by Waters and Stock (*11*). The purpose of the present article is to review briefly some researches on BAL conducted on behalf of the Directorate of Chemical Warfare, Department of National Defence, Ottawa.

Work on BAL was started in Canada late in 1941. The first investigation undertaken was a comparison of the antidotal activity and toxicity of BAL with those of a series of related compounds. In the course of this work the following thiols were synthesized (*4, 12*): 1,2-dimercapto-ethane, 1,2-dimercapto-propane, 1,3-dimercapto-propane, 1,2,3-trimercapto-propane, 1,2-dimercapto-n-butane, 1,3-dimercapto-2-propanol, 2,2′-dimercapto-diethyl ether, 3,3′-dimercapto-dipropyl ether, and 2,2′-dimercapto-diisopropyl ether. These compounds, together with 1- and 2-mercapto-propane and 2-mercapto-ethanol, were tested for antidotal activity to lewisite and toxicity when applied to the skin of the rat (*6, 12*). None of the compounds tested was found to be superior to BAL as an antidote to lewisite. Although none of the monothiols tested showed antidotal activity under the above conditions, all the dithiols and the trithiol studied gave evidence of some antidotal activity. Only in the case of 1,3-dimercapto-2-propanol did this activity approach that of BAL, however, and this compound proved to be much more toxic than BAL.

Rats usually die within 24 hours after the application of lethal amounts of lewisite ($2 \times LD_{50}$) to the skin. Almost invariably, however, the lives of the animals are saved if BAL is applied to the dosed area of skin not later than two hours after dosing with lewisite. Even when treatment with BAL is delayed for a longer period, the animals sometimes survive (*6*). Protection against the systemic effects of lewisite in rats also occurs when BAL is applied to a skin site other than that contaminated with lewisite (*15*), or when BAL in propylene glycol solution is administered by intramuscular injection (*13*). Protective action is also obtained when BAL is applied to the skin two hours, or sometimes even longer, before application of lewisite to another area of skin (*15*)—a finding which can be explained by the low rate of percutaneous absorption of BAL in the rat (*10, 15*).

When applied to the skin of the rat, BAL exerts an antidotal action to sodium arsenite ($2 \times LD_{50}$) administered by intraperitoneal injection (*2*). When rats are dosed intraperitoneally with lethal amounts of cadmium chloride, they sometimes survive if treated percutaneously with BAL. There is evidence, however, that under some conditions deleterious effects follow the administration of BAL to rats poisoned with cadmium (*1*).

The finding of the Oxford workers (*3*) that there is an increased urinary excretion of arsenic following the administration of BAL to rats dosed with lewisite was confirmed and extended. Whether BAL is applied to the skin site contaminated with lewisite, or to a separate site (*14*), or given by intramuscular injection (*13*), the arsenic content of the urine excreted during the 24 hours after dosing with lewisite ($0.5 \times LD_{50}$) is markedly increased when the BAL is given immediately, one or six hours after the lewisite. When the administration of the BAL is delayed for 24 or 48 hours the effect on the urinary excretion of arsenic in the succeeding 24 hours is much less marked. The fecal excretion of arsenic is not influenced to a significant extent by BAL treatment.

Although BAL exerts an antidotal action in sodium arsenite poisoning, its influence on arsenic excretion under these conditions is slight (*2*). On the other hand, whereas rats given intraperitoneal injections of cadmium chloride ($0.5 \times LD_{50}$) show almost no urinary excretion of cadmium, they excrete considerable amounts of cadmium in the urine when also treated with BAL. This tends to prevent the accumulation of cadmium in the liver which occurs when BAL is not administered (*1*).

Radioactive BAL, *i.e.* 2,3-dimercapto-propanol with radioactive sulfur (S^{35}) incorporated in the molecule, was synthesized (*7*) and used in studies of the absorption and metabolism of BAL (*5, 8, 9*). The radioactive compound was obtained by allowing 2,3-dibromo-propanol to react in methanol with sodium hydrosulfide which had been prepared from hydrogen sulfide containing H_2S^{35}.

BAL penetrates skin rather slowly. In experiments with radioactive BAL the average rate of percutaneous absorption of BAL in the rat over a period of six hours was found to be 0.38 mg./cm.^{2} skin/hour (*8*). This value is of the same order as that obtained in preliminary experiments on the rate of absorption of BAL from human skin (*5*). When radioactive BAL dissolved in propylene glycol is injected intramuscularly into rats, it passes rapidly from the site of dosing, for almost no S^{35} is present in the dosed muscle six hours after injection (*9*).

In experiments in which radioactive BAL is administered to rats percutaneously (*8*) or intramuscularly (*9*), S^{35} is distributed throughout the organism and, apart from somewhat higher concentrations in the intestine and its contents and in the kidney, it does not appear to accumulate preferentially in any of the main organs. The most striking feature of such experiments is the rapidity with which S^{35} is excreted in the urine. For example, after an intramuscular injection of a solution of 20 mg. of radioactive BAL in propylene glycol, the amounts of S^{35} present in the urine at 6, 12, and 24 hours after injection corresponded to 45.5, 71.0, and 81.3 per cent, respectively, of the radioactive BAL administered (*9*). A similar rate of excretion of S^{35} is observed when radioactive BAL is administered to the rat by application to the skin (*8*). Studies of the thiol content of the urine and other observations suggest that little of the S^{35} in the urine of rats dosed with radioactive BAL is in the form of unchanged BAL (*5*).

The work described above was supported by grants from the Directorate of Chemical Warfare, Department of National Defence, Ottawa, Canada. Grateful acknowledgment is made to the Director of Chemical Warfare for permission to publish the present article.

References[1]

1. Berenbom, M. Unreported observations.
2. Manson, L. A., Zbarsky, S. H., and Young, L. Report C.P. 85, 1945.
3. Peters, R. A., Stocken, L. A., and Thompson, R. H. S. *Nature, Lond.*, 1945, 156, 616.
4. Simpson, S. D. Report C.P. 48, 1944.
5. Simpson, S. D. Unreported observations.
6. Simpson, S. D., and Young, L. Report C.P. 49, 1944.
7. Simpson, S. D., and Young, L. Report C.P. 79, 1945.
8. Simpson, S. D., and Young, L. Report C.P. 80, 1945.
9. Simpson, S. D., and Young, L. Report C.P. 84, 1945.
10. Simpson, S. D., Zbarsky, S. H., and Young, L. Report C.P. 68, 1944.
11. Waters, L. L., and Stock, C. *Science*, 1945, 102, 601.
12. Young, L. Progress Report No. 21, 1942.
13. Zbarsky, S. H. Unreported observations.
14. Zbarsky, S. H., Manson, L. A., and Young, L. Report C.P. 72, 1944.
15. Zbarsky, S. H., Simpson, S. D., and Young, L. Report C.P. 64, 1944.

[1] The reports to which reference is made were submitted to the Director of Chemical Warfare, Department of National Defence, Ottawa, Canada.

Technical Papers

Thiamine Deficiency and High Estrogen Findings in Uterine Cancer and in Menorrhagia[1]

J. Ernest Ayre and W. A. G. Bauld
*Gyne-cytology Laboratory, Royal Victoria Hospital
McGill University, Montreal*

While studying vaginal and cervical cytology smears for a diagnosis of uterine cancer, the observation was made that over two-thirds of the 150 cases proven to be cancer showed evidence of abnormally high endogenous estrogenic activity. This observation assumed a greater significance when postmenopausal cases of 60 and 70 years of age manifested a cytology picture of estrogenic cornification similar to that of a young woman in the regenerative phase of the sex cycle.

The quantitative production, metabolism, and excretion of the estrogens is even today obscure. Blood assays have proven unsatisfactory, and urinary levels are a measure of the excretion but not of the endogenous level. Our studies lead us to believe that perhaps the simplest and most sensitive measure of endogenous estrin at our disposal today is the specific hormonal cornification reaction manifested in the cells of the squamous epithelium of the vagina.

In humans and in monkeys the estrogens manifest their presence in the vaginal mucosa by a cornification change in the cells, first described by Allen (*1*), which is accompanied by proliferation of the vaginal and cervical squamous epithelium. This growth change is related to the deposition of glycogen in the squamous cell, which is mediated and controlled by the force of the estrogenic stimulus. The vaginal epithelium of the average postmenopausal female is made up largely of basal cells which contain no glycogen, and cornification is absent. Under the influence of the estrogenic hormone the deposition of glycogen may be brought about, and cornification of the squamous cells occurs whether the subject be postclimacteric or following oöphorectomy. This was demonstrated in monkeys by Robertson, Maddux, and Allen (*17*), and in humans by Krumm (*13*). We have confirmed the latter's observations in our own laboratory. We have found further confirmation of the estrogenic activity by studying the endometrium of senile patients suffering from cancer of the cervix. Many of those showing cornification in the smears also exhibited endometrium identical to that found in an active regenerative phase, while in other cases the estrogenic stimulus was sufficient to produce a picture of glandular hyperplasia.

The findings of various investigators using laboratory animals would appear to indicate that liver damage may be induced by dietary deficiency which results in interference with estrogen inactivation. Biskind and Biskind (*3*) demonstrated that in female rats the liver loses its ability to inactivate estrogen in vitamin B-complex deficiency. Addition of brewer's yeast to the diet was found to restore the inactivating mechanism (*5*). The amount of estrogen inactivated by the liver could be controlled at will by withholding the vitamin B complex or by restoring it to the diet.

Singher and his associates (*18*) have demonstrated that thiamine and riboflavin are essential in the metabolism of estradiol by liver slices. The inactivation of estradiol is dependent upon the concentration of these vitamins in the liver, and they state that it seems possible that these vitamins may be involved in estrogen metabolism through their role as members of an oxidative enzyme system.

It has been recognized that menorrhagia and metrorrhagia may occur early in the course of cirrhosis of the liver (*12*), and the work of György and Goldblatt (*9*) and of others has demonstrated that cirrhosis of the liver is known to result from nutritional deficiency. Sources of the B complex have been shown to protect the liver against a variety of toxic agents such as lead, arsenic, and dimethylaniloazobenzene, which cause functional and morphologic damage to this organ. In addition to this evidence, Goldberger (*8*) has shown that menorrhagia may occur in pellagra.

Pincus and Graubard (*15*), in studying estrogen metabolism in seven women suffering from cancer of the uterus, concluded that these cases metabolized the estrogen in an abnormal manner. Their most striking finding was that the total estrogen urinary output after estrone and progesterone administration showed only a slight or negligible increase. The fact that the estrogen could not be accounted for might be explained on the basis of a liver block.

In treating women suffering from menorrhagia, metrorrhagia, and other disorders with large doses of B complex and liver extract, the Biskinds (*4*) report

---

[1] This work aided by a grant from the Ortho Research Foundation. The authors wish to express appreciation to Drs. J. R. Fraser, N. W. Philpott, and J. S. L. Browne for valuable advice and cooperation in the preparation of the work; to the Nutrition Laboratory of the McGill University Clinic; and to Drs. W. Andreae and M. Hoffman for their assistance and advice in regard to the thiamine levels and liver function tests, respectively.

Acknowledgment with thanks is made to the following companies for the supplies of vitamin B_1 and B complex used during the course of this investigation: Lederle Laboratories, Inc., New York City; Winthrop Chemical Company, Windsor, Ontario; Ayerst, McKenna and Harrison, Montreal; E. R. Squibb and Sons, New York City; Charles E. Frosst and Company, Montreal; and Frank W. Horner, Ltd., Montreal.

correction of the functional disorders in a high percentage of cases.

For the past year we have studied 180 ambulatory gynecologic cases suffering from menorrhagia or amenorrhoea. While these patients were not accessible for biochemical assays, it was found possible to add to the clinical findings the simple estrogen determination in the cytology smears before and after administration of thiamine chloride and the other constituents of the B complex and liver extract. While these studies have not been published or completed as yet, one salient feature has been noted, viz., that some definite relationship exists between the intake of B complex and the rise and fall of the estrogenic levels in the body as manifested by the cornification counts in the vaginal smear. Clinically, uniform improvement has been shown in cases other than those proven to have an inflammatory etiology, and the cytology smear findings have given us additional laboratory evidence to help explain why improvement occurred. In some cases we have found a dramatic drop in the cornification level after administration of B complex, as if some part of this preparation were acting specifically in the elimination of the estrogen. It is regrettable that urinary estrogenic levels were not followed at the same time. One might expect that if a block were actually present in the liver, the blood levels and the vaginal cornification would be high and the urine levels low. Coinciding with a drop in the cornification level subsequent to B-complex administration, the urinary estrogen should increase. (Further cases are being studied with a view to verifying this.) Also, the evidence would be more complete if liver function tests were available to assess damage such as might interfere with elimination of the estrogens.

Whether or not the accumulation of uncertain quantities of various estrogens in the body would act as a carcinogen to the susceptible Mullerian tissues and the glands of the breast is open to question. It is known that estrogen is essentially a growth-promoting hormone acting most specifically on the endometrium, which, during each monthly cycle, undergoes the most rapid growth occurring physiologically in the body. Its effect is also specifically exerted upon the squamous epithelium of the vagina. But this same type of epithelium covers the cervix, shows the same cyclic growth changes, and is the tissue most commonly involved in malignancy in the human female.

The role of the estrogens in inducing proliferation of the vaginal epithelium was described in castrate monkeys by Allen (*2*) and has since been confirmed in humans by Shorr and others (*6*). As a result of the injection of estrogens an enormous growth in the vaginal epithelium can be induced, associated with an increase in the number of growing bulbs along the basement membrane, the cells of which contain many mitotic figures. Allen has cautioned that the increased incidence of malignant change following administration of estrogens to cancer-susceptible strains of animals must serve as a warning to the potentialities in the human. While the short life-cycle of mice permits an early recognition of what is carcinogenic, the same influence acting upon human tissues during the same fraction of a lifetime might produce a malignant growth in man. Therefore, it seems possible that errors of diet leading to persistent or intermittent deficiency of such elements as thiamine might cause a persistent estrogenic growth stimulation over a period of years which, acting upon a "locus minoris resistentiae" such as an erosion, ultimately produces a malignant neoplasm.

From our own experiences we may recall cases where we must incriminate an estrogen in the development of cancer. The development of carcinoma in the breast following weekly injections of an estrogen for menopausal therapy is in itself inconclusive evidence. But when such cases occur time and again, they assume greater significance. Dr. J. S. Henry (*10*) has reported two cases in whom the administration of stilbestrol over a period of many months was followed by the finding of malignant growths in the uterus.

It has been found that the implantation of ovarian tissues into mice produced cancer of the breast in cancer-susceptible animals, and it was thought from this that some secretion of the ovary played a role in the production of cancer. It has long been recognised that certain coal tar products produce cancer with greater certainty than any other known chemical or physical irritant. The chemical structure of the responsible substance has been found to be similar to that of some of the active substances in the sex hormones.

Rhoads (*16*) has presented evidence to show that in rats the administration of one of these two-benzene-ring substances, "butter yellow," will result in the development of cancer when their diet consisted of polished rice and carrots. If liver or yeast was added to the basal diet, no cancer occurred. Here, clearly, was an experiment in which a dietary constituent, rich in its content of the vitamins of the B complex, was protective against induced cancer.

A recent survey of evidence of estrogenic activity in 62 granulosa cell tumors has been made by Hodgson, Dockerty, and Mussey (*11*). They stated that "evidence of hyperestrinism is afforded in our series by symptoms of precocious puberty, amenorrhoea, and post menopausal bleeding." They reported proliferative endometrium in 67 per cent of their cases, In 38 postmenopausal patients who had granulosa cell tumor they reported 21 per cent as showing an independent endometrial carcinoma, and in one-third of these cases carcinoma of the breast with axillary metastasis also developed. They concluded that "this phenomenon of co-existent ovarian, endometrial and mammary carcinoma in the human being bears a marked similarity to the results of experiments on laboratory animals in which estrogen stimulation appears to be a factor in carcinogenesis."

During the course of making routine cytological studies on some of our gynecologic bleeders, three cases were encountered in whom similar cytology findings prompted us to investigate the nutritional biochemical status of these patients.

The three cases were 14, 29, and 64 years of age, respectively. The first was suffering from pubertal bleeding which followed a total dental extraction. The other two showed evidence of malignancy in cytology smears, as described so expertly by Papanicolaou and Traut (*14*). All were bleeding excessively, and all showed abnormally high estrogen levels in the cytology smears as well as thiamine deficiency when their urinary excretion levels were analyzed by Dr. Andreae, of the Nutrition Department of the McGill University Clinic.

In the present investigation the vitamin status was estimated by a vitamin-tolerance technique. Following a vitamin-free supper the urine from 12:00 midnight to 8:00 A.M. was collected in a bottle containing acetic acid. In the morning, after a vitamin-free breakfast, an intramuscular injection of 1 mg. thiamine and 1 mg. riboflavin was given and the urine collected for the subsequent four-hour period. Both specimens were analyzed—by the thiochrome method of Wang and Harris (1943) (*19*) for thiamine, and by the Ferrebee (*7*) method (1940) for riboflavin. Patients with below-normal excretion values were classed as deficient in thiamine and/or riboflavin.

The other vitamin B factors measured were normal in amount. Liver function tests were taken on all cases with uncertain results. The first case showed a prolonged prothrombin time, and the second an abnormal cephalin flocculation test (plus 2 in 24 and 48 hours), while the third showed a bromsulfalein retention of 10 per cent. Dr. M. Hoffman, who has studied liver function tests intensively, states that no single test has as yet been elaborated to assess liver damage, and it is possible to have liver damage sufficient to interfere with estrogen elimination without this damage being detectable by the tests at present at our disposal.

The endometrial patterns in these cases verified the high estrogen levels shown by cytology counts. In the first two cases varying degrees of active hyperplasia were found. An endometrial biopsy was not obtained in the third case.

The most striking feature, however, was the evidence of growth manifestations in the 29-year-old case, who exhibited most unusual evidence of proliferation in the squamous tissues of the cervix. Cytology smears taken from the cervix and vagina showed many cornified cells, but in addition there were many immature and anaplastic squamous cells with huge nuclei showing numerous chromatin bundles. Atypical cells were found showing all grades of variability from the normal basal cell to the most bizarre malignant type of cell with the nuclear heteroplasia characteristic of cancer. These findings appear the more remarkable in that no cancer was visible clinically—only a suspicious-appearing erosion encircling the external cervical os. Following surgery, the lesion from which these cells had become desquamated was located. Pathological study left an element of question, however, when one pathologist diagnosed a squamous intraepithelial carcinoma, while another diagnosed it as "precancerous secondary hyperplasia" of the cervix.

The tissue study in the case of the 14-year-old case of pubertal bleeding proved interesting also. Grossly, the tissue was thick, abundant, and polypoidal, while microscopically, various areas presented an appearance of overstimulated proliferative glands with mitosis and adenomatous formation such as would make the pathologist think twice before eliminating a diagnosis of precancerous change if found in a 40-year-old. Yet such a diagnosis would seem fantastic in a child of 14 years!

The third case exhibited a typical squamous carcinoma of the cervix, an early small lesion, but a rapidly growing undifferentiated neoplasm.

One might readily expect that a cancerous victim in the throes of cachexia might show justification for deficiency, but investigation into the dietary intake reveals that in the two cases of neoplasm, the lesions were early and asymptomatic except for the bleeding. The 29-year-old case was suffering from chronic constipation, abdominal cramps, and nausea brought on by solid food, which restricted her to a liquid or soft diet. In addition, she was a moderately heavy drinker.

The other case revealed excellent nutrition externally, but she admitted that she dieted constantly to keep her weight down, and analysis of her diet revealed an inadequate thiamine intake.

NUTRITIONAL STUDIES

It perhaps seems remarkable in these days of scientific enlightenment and dietary refinement that deficiency would occur irrespective of the economic status of the patient. It has long been a general feeling among gynecologists that dietetics were not directly concerned with the production of pelvic pathology, and that the need for vitamins in particular was generally overstressed. It would seem logical that the average person with a normal appetite for the various staple foods should not develop a deficiency due to an inadequate intake. A study of thiamine physiology and metabolism reveals evidence to indicate that this substance would appear to be particularly vulnerable to intermittent or chronic depletion without gross deficiency in the diet as a whole. This tendency would appear to depend upon the fact that little thiamine is stored in the organism and the amount is sufficient only to maintain proper life for a few days. A daily intake of thiamine is necessary, and the organism absorbs only enough for the immediate needs, the excess being destroyed or excreted. More is required when alcohol is imbibed or when a high carbohydrate diet is taken. Fats, on the other hand, spare thiamine. This may account for the finding of deficient levels in well-nourished but obese patients who are constantly dieting. We have found that a vicious cycle may occur, as anorexia and constipation frequently develop in the presence of a deficiency. Therefore, the greater the anorexia the more pronounced the deficiency.

With so much discussion of vitamin therapy nowadays, one might be led to believe that they are a "cure-all." The truth, however, is that vitamins are only nutritional elements, and to say that a vitamin would cure a deficiency or a disease resulting from a deficiency is simply to say that a well-balanced diet, properly absorbed and utilized, would have prevented the disorder.

After observing the consistency of finding "B" deficiency in so many gynecologic cases, one naturally wonders if half the population may be deficient. If so, the reported findings would lose much of their significance. But this is not the case. Dr. Andreae reports that of the cases in the Royal Victoria Hospital tested because of a suspected deficiency, only one in eight has been proven to be deficient. Further, our own controls of nongynecologic cases reflect the same normalcy.

Speculation arising from an analysis of the findings in the cases herein presented suggests the inference that the thiamine deficiency was causally related to the pathological conditions found. A possible mechanism to explain functional bleeding and the development of a malignant growth in the estrogen-susceptible pelvic tissues presents itself. Is it possible that the dietary deficiency, acute in the case of pubertal bleeding, and chronic in the two cases of cancer, produced some barely demonstrable liver damage which was sufficient to inhibit this organ from conjugating the estrogens necessary to permit their inactivation? Is it possible that the accumulation of the estrogenic substances produced the overgrowth of the endometrium, resulting in endometrial hyperplasia with its characteristic bleeding? And is it possible that as a result of such liver damage the estrogen accumulating in the system, unable to escape, continually exerting its growth stimulation upon the pelvic tissues over a period of years, leads to an actual carcinoma?

SUMMARY

The finding of abnormal estrogenic activity coupled with thiamine deficiency in cases of menorrhagia and uterine cancer suggests a possible etiological correlation between the dietary deficiency, the abnormal estrogen level, and the pathological lesion.

The specific element deficient in these cases was thiamine, while the other B factors were normal.

Preliminary report of the evidence is made in this small series while more extensive studies on a large series of cases are being pursued.

Cornification in cytology smears was used to study estrogenic activity, since the present study was prompted by cytological findings; the method is simple, practical, and reasonably accurate. The urinary estimation measures only the amount excreted, and if liver impairment actually is present, the quantity excreted would not give a true index of the amount retained in the body.

Further studies are being undertaken in which estrogenic, urinary, and cornification levels are being compared before and after thiamine administration in cases proven to be deficient.

Supplement. Since the original submission of this paper, further cases have been investigated. Of 20 cases suffering from proven uterine cancer, 90 per cent of these were found to have a low thiamine excretion coupled with an abnormally high endogenous estrogen level. The average thiamine excretion level was found to be less than half the average levels found in a control group which showed normal estrogen levels.

Of the 20 cancer cases studied, 20 per cent showed also a deficient excretion of riboflavin.

A similar group of menorrhagic patients was studied and showed the same co-relation of thiamine deficiency and an abnormally high estrogenic level.

In an attempt to explain why some cases develop menorrhagia and others cancer, the time element may enter the picture. Since most people develop a fixed habit of diet, a dietary error over a period of time would tend to produce a chronic deficiency. If this acts on the human liver in the same way as in animals, it would seem logical that even small amounts of estrin, not being inactivated by the liver would accumulate in the body and at the same time act as a chronic growth stimulant to the estrin-susceptible tissues, viz., the pelvic organs and possibly also the glands of the breast.

The fact that dietary errors tend to be chronic is shown in certain of our cancer cases, where even after cure, or a remission of months or years, they return to the same habits of diet and continue to show thiamine deficiency. While we must also consider the possibility of an internal metabolic defect leading to the deficiency, this would tend to be countered by the fact that with correction of dietary intake the deficiency was corrected in our cases. Whether or not these cases require an increased quantitative intake of these essentials to maintain a normal level remains to be investigated.

CONCLUSIONS

When we couple the findings with the background of what has been proven in animals, there appears to be excellent circumstantial evidence to suggest that the nutritional deficiency may have been a primary factor leading to the malignancy.

Whether this low thiamine excretion is due to an actual primary dietary deficiency or to some internal metabolic change is a subject for further investigation. In either case, if this hypothetical mechanism proves to be correct, it means that we are presented with the means not only of diagnosing uterine cancer by cytological findings but of actually detecting a potential cancer-producing mechanism even before the cancer develops! Two simple tests would be used: (1) a cervical cytology test, which would tell (a) if the person had uterine cancer, and (b) if not, whether the endogenous estrogen level was abnormally high, in which case the second test should be done; and (2) a test of the urinary thiamine level.

The finding of a combination of low thiamine and abnormally high estrogen could be recognized as a dangerous precancerous linkage. Recognition of this would permit correction and possible prevention of the cancer.

No single track of investigation yields a conclusive answer to the cancer enigma, but when we piece together the evidence of animal experimentation, cytopathological, hormonal, and nutritional findings, there seems to be evidence that progress in the right direction is being made.

References

1. Allen, E. *Amer. J. Anat.*, 1934, **34**, 183.
2. Allen, E. *J. Amer. med. Ass.*, 1935, **104**, 1496.
3. Biskind, M. S., and Biskind, G. R. *Endocrinology*, 1942, **31**, 109.
4. Biskind, M. S., Biskind, G. R., and Biskind, L. H. *Surg. Gynec. Obstet.*, 1944, **78**, 49.
5. Biskind, M. S., and Shelesnyak, M. C. *Endocrinology*, 1942, **30**, 819.
6. DeAllende, Ines, L. C., Shorr, Ephraim, and Hartman, Carl G. In *Contributions to embryology. Carnegie Inst. Publ.* 557, 1943, **32**, 1–26.
7. Ferrebee, J. W. *J. clin. Invest.*, 1940, **19**, 251.
8. Goldberger, J. Tice's *Practice of medicine.* (Rev. by W. H. Sebrell.) Vol. 9, 1932, p. 205.
9. György, P., and Goldblatt, H. *J. exp. Med.*, 1942, **75**, 355.
10. Henry, J. S. *Canad. med. Ass. J.*, 1945, **53**, 31.
11. Hodgson, J. E., Dockerty, M. B., and Mussey, R. D. *Surg. Gynec. Obstet.*, 1945, **81**, 631–642.
12. Kelly, A. O. J. *Osler's mod. Med.*, 1908, **6**, 775.
13. Krumm, J. F. *Amer. J. Obstet. Gynec.*, 1936, **31**, 1035.
14. Papanicolaou, G. N., and Traut, H. F. *Amer. J. Obstet. Gynec.*, 1941, **42**, 193.
15. Pincus, G., and Graubard, M. *Endocrinology*, 1940, **26**, 430.
16. Rhoads, C. P. *Bull. N. Y. Acad. Med.*, 1942, **18**, 53.
17. Robertson, D. C., Maddux, W. P., and Allen, E. *Endocrinology*, 1930, **13**, 77.
18. Singher, H. O., Kensler, C. J., Taylor, H. C., Jr., Rhoads, C. P., and Unna, Klaus. *J. biol. Chem.*, 1944, **154**, 79.
19. Wang, Y. L., and Harris, L. J. *Brit. med. J.*, 1943, 451.

The Antibacterial Activity of Protamine Zinc Insulin[1]

Carol Houck Bollenback and Sidney W. Fox

Chemistry Section, Iowa Agricultural Experiment Station, Ames

As part of a program of chemical and biological study of proteinaceous antibacterials (*3*), it seemed desirable to test the effect of protamine insulin combinations of the kind used routinely in the control of diabetes (*1*). The antibacterial property of the protamines, clupein (*5*), and salmine (*7*), had previously been reported. Protamine sulfate prepared from shad of the Sacramento River by one of us (S.W.F.) has also been found to possess comparable activity (*2*). The experiments recorded below indicate that protamine is able to act as an antibacterial, even though combined in a relatively insoluble form with insulin.

The tests were conducted on cultures of *Lactobacillus arabinosus*, *Staphylococcus aureus*, and *Escherichia coli*. Both the supernatant liquid of centrifuged protamine zinc insulin preparations and the whole suspension, with appropriate controls, were tested. All tests were run in solutions buffered by phosphate. The contents of the tubes were initially at pH 7.1–7.4. *Lactobacillus arabinosus* was cultured at 30° in the special Bacto-Peptone medium of McMahan and Snell (*6*) and in the synthetic medium of Kuiken, *et al.* (*4*). The other two organisms were cultured at 37° in the usual beef extract broth. The observations recorded in Table 1 were made at 24 hours from tube cultures. All results were confirmed by plate cultures read at 48 hours. These plate cultures were made from well-shaken suspensions after an initial growth in

---

[1] Journal Paper No. J-1288 of the Iowa Agricultural Experiment Station, Project 897, in cooperation with the Veterinary Research Institute.

tubes for 24 hours. In order to test the possibility that the cells are prevented from proliferating because of engulfment within the solid, shake cultures were run on *Lactobacillus arabinosus* with a suspension of protamine zinc insulin at a concentration that was close to the threshold value in tubes. Results comparable to those for cultures in tubes were obtained.

TABLE 1

LOWEST DILUTIONS OF PROTAMINE AND INSULIN PREPARATIONS PERMITTING GROWTH IN SEVERAL SPECIES OF BACTERIA

Microorganism	Protamine zinc insulin suspension	Protamine zinc insulin supernatant solution	Salmine	Zinc insulin
L. arabinosus on Bacto-Peptone medium	$\frac{1}{20{,}000}$	N.I.*	$\frac{1}{85{,}000}$	N.I.
L. arabinosus on synthetic medium	$\frac{1}{40{,}000}$	N.I.	$\frac{1}{200{,}000}$	N.I.
Staph. aureus Heatley	$\frac{1}{20{,}000}$	N.I.	$\frac{1}{50{,}000}$	N.I.
E. coli	$\frac{1}{10{,}000}$	N.I.	$\frac{1}{25{,}000}$	N.I.

* N.I. signifies no inhibition by the undiluted solution. The undiluted solution of zinc insulin contained 1.8 mg. of zinc insulin powder (Lilly) per cc. Dilution figures in the table refer to the fraction: weight of substance tested/weight of solution tested.

Effective concentrations were determined by testing successive twofold dilutions of the original solution or suspension. All solutions were sterilized by Seitz filtration, and all mixtures were aseptically prepared from such solutions. The protamine zinc insulin preparation was obtained from commercial ampoules. The zinc insulin powder and salmine sulfate were the gifts of Mr. George Walden, of Eli Lilly and Company, to whom our thanks are expressed.

The phenol used as a preservative in protamine zinc insulin preparations contributes but slightly to its antibacterial activity. The data in Table 1 indicate inappreciable antibacterial activity for the supernatant liquid of centrifuged preparations. Substantially the same antibacterial activity was recorded for protamine zinc insulin suspensions prepared in this laboratory without the inclusion of any added preservative. The observed antibacterial effects are therefore not attributable to the phenol found in commercial preparations.

The activity of protamine zinc insulin appears to be approximately equivalent to the activity of the contained protamine (3.5 parts of protamine zinc insulin contain 1.25 parts of protamine). It seems reasonable to conclude, therefore, that the salmine zinc insulin dissociates to liberate salmine. This behavior is comparable to the gradual release of insulin for its regulated action when administered in insoluble complex form with protamine.

These observations indicate that there may be a previously unrecognized medical utility in the inclusion of protamine in insulin preparations.

References

1. AMERICAN MEDICAL ASSOCIATION. *New and non-official remedies*, 1944, 431.
2. FOX, S. W., BOLLENBACK, C. H., and FLING, M. Unpublished experiments.
3. FOX, S. W., FLING, M., and BOLLENBACK, G. N. *J. biol. Chem.*, 1944, **155**, 465.
4. KUIKEN, K. A., NORMAN, W. H., LYMAN, C. M., HALE, F., and BLOTTER, L. *J. biol. Chem.*, 1943, **151**, 616.
5. MCCLEAN, D. *J. Path. Bact.*, 1931, **34**, 459.
6. MCMAHAN, J. R., and SNELL, E. E. *J. biol. Chem.*, 1944, **152**, 84.
7. MILLER, B. F., ABRAMS, R., DORFMAN, A., and KLEIN, M. *Science*, 1942, **96**, 428.

Scanning Science—

Almost the only power clearly and expressly vested in Congress by the Constitution which has remained practically unexercised to the present day is that of fixing the standard of weights and measures. For more than a generation we lived with no legal standard by which could be determined even the amount of metal which went into the coin that came from our mints. Gallatin procured from France a platinum kilogram and meter in 1821 and from England a troy pound in 1827, and in 1828 the latter was recognized as the standard for mint purposes. In 1830 the Senate directed the Secretary of the Treasury to have a comparison made of the standards of weight and measure used at the principal custom houses of the United States and report the same to the Senate. This was done, and large discrepancies and errors were found to exist. Varying scales and varying measures inevitably produced varying rates of duty. The Treasury Department, therefore, in the exercise of its executive power and as a necessary incident and means to the execution of the law and the observance of the Constitution, adopted for the use of that Department the Troughton scale, then in the possession and use of the Coast Survey, as the unit of length, and the troy pound of the mint as the unit of weight. From the latter the avoirdupois pound was to be derived, assuming that they were 7,000 grains in the pound avoirdupois to 5,760 in the pound troy. By the Act of March 3, 1881, similar sets of standards were directed to be supplied to the various agricultural colleges which had received land grants from the United States at a cost not exceeding $200 for each set. This law was complied with as best it could be under the limitation of cost prescribed.

—27 March 1896

U. S. News and Notes

Capt. R. D. Conrad, USN, director of the Planning Division, Office of Research and Inventions, has been awarded the Legion of Merit. The award was made to Capt. Conrad for exceptionally meritorious services to the country in guiding research during the war years as planning head for the Office of the Coordinator of Research and Development. Rear Adm. H. G. Bowen, chief of Research and Inventions, made the award on behalf of Secretary Forrestal.

Dr. Merle A. Tuve, since 1938 chief physicist of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, has been appointed director of the Department of Terrestrial Magnetism, to succeed Dr. John A. Fleming. Announcement of the appointment was made on 26 March by Dr. Vannevar Bush, president of the Carnegie Institution. Dr. Fleming, a member of the Carnegie Institution's scientific staff since 1904 and director of the Department of Terrestrial Magnetism since 1935, will retire.

Dr. J. Allen Scott, of the University of Texas Medical School, who spent last summer in Brazil on a government health mission, recently addressed the Kansas State College Chapter of Sigma Xi on "Health Problems in the Amazon Valley."

Dr. D. H. Wenrich, of the University of Pennsylvania, will serve as acting editor of the *Journal of Morphology,* published by the Wistar Institute, until a new editor is appointed by the American Society of Zoologists. The vacancy was caused by the death, on 17 January 1946, of Dr. C. E. McClung, who served as managing editor for 25 years.

Lt. Col. Charles H. Greenall, director of research at Frankford Arsenal, has been named executive director of the Franklin Institute Laboratories, Philadelphia. Dr. Henry Butler Allen is secretary and director of the Institute.

Senior consultants to Dr. Allen will be Dr. Rupen Eksergain, of Media, chief consulting engineer for the Edward G. Budd Manufacturing Company, and Dr. W. F. G. Swann, of Swarthmore, director of the Bartol Research Foundation of the Franklin Institute on the campus of Swarthmore College.

Three other members of the administrative personnel named for the laboratories are Dr. Nicol H. Smith, director of the Division of Chemical Engineering and Physics, and Ralph H. McClarren, Division of Electronics and Instruments, both of whom are associate directors of the Institute museum; and George S. Heoll, Division of Mechanical Engineering.

Dr. J. Wyatt Durham has been made associate professor of invertebrate paleontology at California Institute of Technology. He will join the staff in August 1946.

Dr. Lee A. DuBridge, director of the NDRC Radiation Laboratory, Cambridge, returned to the University of Rochester on 15 February to resume his headship of the Department of Physics. At Cambridge Dr. DuBridge supervised the work of 3,900 people on a budget of some $4,000,000 a month.

Dr. Richard H. Jahns has been made assistant professor of geology at the California Institute of Technology.

Dr. Harold C. Urey, returned to his Alma Mater, Montana State University, as the principal speaker at a Charter Day celebration of the completion of 50 years existence of that institution. Dr. Urey spoke also at the Missoula County High School, at the annual meeting of the Missoula Chamber of Commerce, and before the University Sigma Xi Club.

Dr. Jackson W. Foster has resigned as head of the Microbiological Research and Development Department at Merck and Company, Inc., to accept an appointment as associate professor of bacteriology at the University of Texas, Austin.

Dr. Paul B. Sears, professor of botany and head of the Department of Botany at Oberlin College, has recently been appointed a member of the State Commission on Conservation and Natural Resources for the State of Ohio by Governor Frank J. Lausche.

Dr. Laurence H. Snyder, of the Ohio State University, addressed the New York Academy of Science on 11 February on the topic: "Recent Advances in Human Heredity."

Dr. Julius Ashkin, who was at Los Alamos for three years, has been appointed assistant professor of physics at the University of Rochester.

Cecil W. Mann has been promoted to a full professorship in psychology at the Tulane University of Louisiana.

G. W. Bergren, instructor in mechanical engineering at Purdue University, has returned to the University after four and a half years of service with the Navy.

Announcements

Dr. Arthur H. Compton, chancellor of Washington University, spoke at the luncheon at which the medals and scrolls were presented to 13 science writers as part of the George Westinghouse Science Writing Awards on Wednesday, 27 March, at St. Louis.

Dr. Compton pointed out that the rapid changes going on in the world are largely a result of scientific insight and technology based on scientific achievement. He paid tribute to the profession of science writing because it helps to keep people aware that it is science that is causing the day to day changes in the world. He observed that science writing for the general public is a steadying influence in a changing world because it helps people to anticipate changes in their lives before these changes are really upon them. This helps to make people feel at home in what would otherwise be a strange world. Dr. Compton also pointed out that science writers ". . . would do well to call more attention to the fact that a society which is based upon science is a society of specialists, and that specialists form a strong society only when cooperation is effective. This means that the growth of science implies a need for greater attention to understanding, tolerance, and coordination of effort between the various components that make up our society. We have found that science does not advance without dividing into specialties; society needs these specialties. Here, then, in a new sense is a need for cooperation if our society is to function. Prejudices and intolerances, whether between professions, or races, or economic groups, become a supreme social hazard. The desire to work together for the common good becomes the supreme virtue in a society of scientific specialists."

Ralph Coghlan, editor of the editorial page, *St. Louis Post-Dispatch,* also spoke in a humorous and intimate fashion, pointing out that although the press has so often mutilated scientific theory, misrepresented it, and often unduly raised the hopes of people by prematurely announcing cures of deadly diseases, scientists themselves are responsible for this state of affairs, having lived too long in ivory towers and enjoyed to the full their intellectual snobbery.

Dr. Anton Carlson presented the medals, saying that, however good science writing is now, much remains to be done, as witnessed by scientifically stupid, ignorant actions on the part of the public.

A Microbiological Section of the Botanical Society of America, Inc., was established at the St. Louis meeting of the Society. The Microbiological Section will be comprehensive in scope and organization and includes mycologists, plant physiologists and biochemists interested in microorganisms, pathologists, algologists, protozoologists, bacteriologists, medical mycologists, and students of antibiotics. It will, accordingly, provide the organization and outlet for publication for research workers on microorganisms.

Following organization of the Microbiological Section at St. Louis, a program on microbiology was presented on the afternoon of 28 March. Dr. Paul R. Burkholder, of Yale University, and Dr. Kenneth B. Raper, of the Northern Regional Research Laboratory, Peoria, Illinois, were elected chairman and secretary, respectively, of the Microbiological Section. The new Section was organized in view of the growing importance of microorganisms in the production of antibiotics and in general botanical, bacteriological, and industrial research.

The Editorial Board of the American Journal of Botany announces the election of Prof. Bernard S. Meyer as editor-in-chief to succeed Dr. Ralph E. Cleland. Dr. Meyer assumed his duties on 22 March. All manuscripts and correspondence relating to editorial matters should be addressed to Prof. Bernard S. Meyer, Botany Department, Ohio State University, Columbus 10, Ohio.

The Central Institute for the Deaf in St. Louis and the Harvard University Psycho-Acoustic and Electro-Acoustic Laboratories, operating under OSRD, have devised new methods of testing the degree of deafness of returning veterans with impaired hearing. All of the currently approved commercial hearing aids, 14 in number, were tested.

With the assistance of conscientious objectors and of volunteers who are themselves hard of hearing, tests were conducted over a period of two years to find out more about how the partially deafened ear really works and to measure the loudest sound which both the normal and deafened subject can tolerate with comfort.

Differences in the performance among hearing aids proved to be much less than had been anticipated, but since hearing aids are devices to which persons become accustomed, individual preferences do have to be reckoned with.

The scientific program, known as the Hearing-Aid Project, was established with the assistance of Col. M. R. Mobley, later awarded the Legion of Merit, in close liaison with military hospitals where soldiers and sailors with impaired hearing were diagnosed and fitted with hearing aids.

The Central Institute for the Deaf planned and assembled equipment for military hospitals, suitable for testing impairment of hearing and selection of the hearing aid best suited to each patient.

Apparatus for the tests were installed at the Deshon General Hospital, Butler, Pennsylvania; the Borden General Hospital, Chickasha, Oklahoma; the Hoff General Hospital, Santa Barbara, California; and the U. S. Naval Hospital, Philadelphia, Pennsylvania.

New methods of testing developed at Harvard's Psycho-Acoustic Laboratory under direction of Hallowell Davis, associate professor of physiology, who now has become the new research director of the Central Institute for the Deaf, are based on the ability to hear and understand speech. They supplement the familiar test of hearing by the audiometer, which employs relatively pure tones.

By these new methods, carefully chosen lists of words or sentences are delivered by earphones or loudspeaker in an acoustically treated, sound-proof room. Loudness is measured and regulated electrically. Tests have been standardized by the use of phonographic recordings or by training technicians to speak in standard manner into a microphone. A standard noise can be added electrically if desired.

To provide basic information for the design of hearing aids, the Central Institute for the Deaf determined the limits of tolerance for normal and for hard-of-hearing ears.

It has been suggested in recent years that a hearing aid should fit, *i.e.* compensate in detail for each patient's individual hearing loss, much as a pair of eyeglasses is prepared by individual prescription. In these experiments, however, for all types of hearing loss, better results were obtained with an instrument which provided high fidelity amplification over an adequate range of frequencies rather than selective amplification. The ideal hearing aid should deliver speech at the maximum necessary loudness with a minimum of distortion.

Six graduate teaching and research assistantships are offered by the Department of Zoology of the Graduate School and the College of Liberal Arts of Syracuse University. The duties consist of half-time work largely in undergraduate teaching, and in some cases in assisting in experimental research projects. It is expected that the remaining portion of the student's time will be spent in graduate study in the Department of Zoology and allied departments leading to the M.A. degree (two years) or Ph.D. Thesis work leading to advanced degrees may be taken in the following fields: invertebrate zoology, vertebrate zoology, general physiology, vertebrate physiology, endocrinology, cytology, protobiology, and parasitology.

These appointments, open to graduates with high scholastic records from any accredited university or college, are made for two terms during the year 1946–47. The assistantships carry a stipend of $1,000 each for the year except in the case of veterans qualifying under the G. I. Bill of Rights, who will receive $800, since tuition in these cases is provided by the Government. Assistance during the summer term or summer session carries an extra stipend.

Application blanks may be obtained from: Dr. R. D. Manwell, secretary, Department of Zoology, Lyman Hall, Syracuse University, Syrause 10, New York.

Formation of the Soil Conservation Society of America, a professional organization for workers in that and allied fields, is announced by J. H. Christ, of Portland, Oregon, national secretary-treasurer. Ralph H. Musser, of Milwaukee, Wisconsin, is president of the society that enrolled 1,500 members in 1945, the year it began to function. A. E. McClymonds, of Lincoln, Nebraska, is vice-president.

The society was organized to "promote and advance all phases of the science of conservation of soil and water resources; to provide a medium for exchange of facts, experience, and thought; and to present, advance, and protect the standards of the science of soil and water conservation." Dr. Hugh H. Bennett, of Washington, D. C., chief of the Soil Conservation Service of the U. S. Department of Agriculture, is founder of the society.

Plans have been made to publish a quarterly journal, beginning in the last half of 1946. The annual dues are $3.00; the address of the secretary-treasurer, P. O. Box 671, Portland 7, Oregon.

The following statement was unanimously adopted at a membership meeting of the Philadelphia Branch of the American Association of Scientific Workers, 2303 Delancey Place, Philadelphia 3, Pennsylvania, on 28 February 1946:

> The current spy scare confirms the repeated contention that surrounding atomic energy in a veil of secrecy hampers freedom of research and even threatens world peace.
>
> Scientists have repeatedly emphasized that atomic research cannot be kept secret. However, the illusion of secrecy that prevails at this time inevitably produces an atmosphere of intrigue, rumor-mongering, and distrust among nations. Thus, the Canadian accusations, magnified by the press, have alarmingly strained normal relations between Canada and the Soviet Union. Critical incidents of this sort will continue until all the facts about the making of atom bombs are in the hands of the Security Council of the UNO, where this knowledge can be used by all nations harmoniously, in the interest of peace.
>
> Scientists particularly should note the fact that members of the National Research Council of Canada were among those accused in the spy episode. One is made aware that no laboratory will be inviolate if hysteria about "atomic secrets" is allowed free rein. This

danger was dramatically brought home to us in America when General Groves made the outrageous charge that ''atomic secrets'' had leaked out through the testimony of scientists favoring the McMahon Bill, which provides for civilian control of atomic research. Scientists resent this slur on their integrity and will fight any attempt to intimidate them and prevent them from taking their rightful place in the discussion on control of atomic energy.

We suggest that scientists, and others who are concerned to see the discovery of atomic energy perverted into channels which hinder progress rather than furthering it, do the following:

1. Write President Truman and Secretary of State Byrnes urging that international tensions surrounding the question of the use of atomic power be ended by the *immediate* turning over of all information on the subject to the Security Council of the UNO.

2. Write Senator McMahon in support of his bill, S. 1717, because it would allow the freest expansion of research in nuclear physics.

The four hundred fourteenth meeting of the American Mathematical Society was held at Columbia University on Saturday, 23 February 1946.

The Association for Symbolic Logic also met on 23 February 1946 at Columbia University.

Meetings

The National Academy of Sciences will hold its annual meeting on 22, 23, and 24 April in Washington, D. C. Sessions for the presentation of invited scientific papers will be held in the auditorium of the New National Museum and will be open to the public. The program follows:

Monday, 10: 00 A.M.–12: 30 P.M.—"Establishment and Activities of USN Medical Research Unit No. 2 in the Pacific": T. M. Rivers, Rockefeller Institute for Medical Research; "Antimalaria Compounds": C. S. Marvel, University of Illinois; "The Study of the Antimalarial Activity in the Human": J. S. Shannon, Goldwater Memorial Hospital; "Antibiotics With Special Reference to Streptomycin": S. A. Waksman, Agricultural Experiment Station, New Brunswick; "Penicillin and Syphilis": J. E. Moore, Johns Hopkins University; "Insecticidal Action and Chemical Composition of Organic Compounds": A. L. Haller, U. S. Department of Agriculture; "Submarine Propagation of Sound Waves": M. E. Ewing, Columbia University.

Monday, 2: 00 P.M.–5: 00 P.M.—"Screening and Toxic Smokes": W. H. Rodebush, University of Illinois; "Catalytic Cracking of Petroleum Oils": W. K. Lewis, Massachusetts Institute of Technology; "Chemistry in Germany Today": Roger Adams, University of Illinois; "Explosives in World War II": C. B. Kistiakowsky, Harvard University; "The Mechanism of the Emulsion Polymerization of Rubber and Other Polymers": W. D. Harkins, University of Chicago; "Recent Developments in Meteorological Equipment": A. F. Spilhaus, New York University; "Waves and Vortices in the Atmosphere": J. Bjerknes, University of California, Los Angeles; "Progress in the AAF Toward the Development of a Science of the Use of Human Resources": Col. J. C. Flanagan, AAF; "Inequalities in Adult Capacity—From Military Data": W. V. Bingham, War Department.

Monday, 8: 30 P.M.—"Science in the Framework of International Policy": Isaiah Bowman, president, Johns Hopkins University.

Tuesday, 10: 00 A.M.–12: 30 P.M.—"Jet Propulsion": J. C. Hunsaker, Massachusetts Institute of Technology; "Some Recent Advances in Aerodynamics": H. L. Dryden, National Bureau of Standards; "The Radio Proximity Fuse": M. A. Tuve, Carnegie Institution of Washington; "Microwave Radar": L. A. DuBridge, University of Rochester; "Physical Properties of Microwaves": I. I. Rabi, Columbia University; "Developments in Photogrammetry During World War II": Gerald Fitzgerald, U. S. Geological Survey; "Some War-accelerated Communication Developments": O. E. Buckley, Bell Telephone Laboratories.

The American Society of Ichthyologists and Herpetologists will hold its Twenty-sixth Annual Meeting (the first since 1942) at Carnegie Museum, Pittsburgh, Pennsylvania, 16–18 April 1946. The annual banquet will be held on Wednesday, 17 April, at which time Karl P. Schmidt, chief curator of zoology, Chicago Natural History Museum, will give a presidential address on "The New Systematics, the New Anatomy, and the New Natural History."

Three members of the Society have generously provided funds for prize awards for noteworthy papers read by junior members, at both the Annual and Western Division meetings of the Society. First and second prizes of $25 and $15 in both ichthyology (including fisheries biology) and herpetology are offered, the awards to be granted only if papers of suitably high quality are presented.

The thirteenth E. Starr Judd lecture will be given by Dr. Samuel C. Harvey, William H. Carmalt professor of surgery at Yale University, on Monday evening, 15 April at 8: 15 in the Medical Science Amphitheater, University of Minnesota. Dr. Harvey's subject will be: "The Healing of the Wound."

International News and Notes

Dr. Albert F. Blakeslee, visiting professor of botany at Smith College and director of the Smith College Genetics Experiment Station, has been elected an Honorary Fellow of the National Institute of Sciences of India.

Dr. E. D. Merrill, director of the Arnold Arboretum, Harvard University, was elected a foreign member of the Royal Swedish Academy of Sciences, Stockholm, to fill the vacancy caused by the death of Dr. L. Diels.

Dr. Alvin R. Lamb, Lt. Col., Sanitary Corps, has returned to his work with the Experiment Station, Hawaiian Sugar Planters Association, after five years in Army service. He served three and one-half years on the staff, Hawaiian Department and Central Pacific Area, and one and one-half years in New Guinea and the Philippines.

Dr. Oscar Riddle, now visiting professor in various South American countries under the auspices of the Department of State, has been elected to honorary membership in the Sociedad de Biologia de Montevideo and to corresponding membership in the Sociedade Brasileira de Patologia Clinica.

The State Department Report on International Control of Atomic Energy is becoming known as the Acheson Report. Dean Acheson, Undersecretary of State, was the chairman of a committee, consisting of Vannevar Bush, James B. Conant, John C. McCloy (former Assistant Secretary of War), and Maj. Gen. Leslie R. Groves, which was set up by the State Department to pass on the recommendations of the Board of Consultants who actually prepared the report. The Board consisted of: Chester I. Barnard, president, New Jersey Bell Telephone Company; David Lilienthal, chairman, Tennessee Valley Authority; J. Robert Oppenheimer, Los Alamos Atomic Laboratories; Charles Allen Thomas, vice-president, Monsanto Chemical Company; and Harry A. Winne, vice-president General Electric Company. These five men of widely different backgrounds and experience, after a study of one month's duration, concluded in complete agreement with each other that a plan for the international control of atomic energy was feasible and were also in agreement on the essentials of a plan.

Secretary of State Byrnes, in a foreword, explained that the report was not issued as a statement of policy, but as a point of departure for informed public discussion.

As President Conant had revealed earlier in an informal presentation to the Council of the AAAS at St. Louis (*Science,* 1946, **103**, 428), the plan hinges on free access to a new denatured uranium and thorium. A denaturing process, announced for the first time, would make "the material unusable by any methods we now know for effective atomic explosive unless steps are taken to remove the denaturant." It is then pointed out that any known methods for removing the denaturant would involve plants of great size and personnel of such magnitude that they could not be concealed. The report proceeds to distinguish between safe and dangerous operations. The safe activities are listed as (1) the use of radioactive material as biological tracers; (2) small nuclear reactors which can be operated at a power level low enough to be incapable of producing dangerous quantities of fissionable materials and high enough to provide neutron sources and gamma ray sources of hitherto impossible power magnitudes; (3) the development of power from the fission of denatured U-235 and plutonium, such power reactors operating in the range of 100,000 to 1,000,000 kilowatts. If no additional uranium or thorium is available to these plants, they cannot produce any further fissionable material. The operation of the plant would use up the uranium and plutonium. A minimum of supervision should make it possible to prevent the substitution of uranium and thorium for other inert materials which could be used freely.

A survey of world resources of ores yielding uranium and thorium is contemplated, and their mining is to be placed under management of a responsible United Nations agency as well as the ownership and management of the primary separation plants themselves.

The report is much too long to print in *Science,* but a printed edition of the complete text is available from the National Committee on Atomic Information, 1621 K Street, N. W., Washington 6, D. C. at $.20 a copy or $15 a hundred.

The Peking Man, taken to Japan by the Japanese army as loot during the occupation, is to be returned to the National Geographical Survey Society of China. According to Reuter, in a dispatch dated 29 December 1945, Tokyo University is reported to have surrendered the bones and artifacts to the allied authorities in Japan.

Japanese army scientists found the Peking Man in Peking after a three-year search, and specialists supervised its removal to Tokyo. None of the bones, utensils, and personal adornments, charts, or other documents accompanying the relics appears to have been damaged.

The formula of "Paludrine" (*Science,* 1946, **103**, 204), the new synthetic antimalarial agent, has now been announced; it is N_1-*p*-chlorophenyl-N_5-isopropylbiguanide, and is used in the form of a salt such as the hydrochloride. The drug, whose discovery was announced last November, promises to prove at least as effective as mepacrine in the treatment of malignant tertian and benign tertian malaria; and so far no toxic effects have been reported. Imperial Chemical Industries, in whose laboratories paludrine was discovered, has started limited production, and is preparing for full-scale manufacture; it is expected that it will cost less than mepacrine. Mr. F. H. S. Curd and Mr. F. L. Rose, who synthesized the drug, gave an account of its development to the Chemical Society in London on 7 February. Mr. D. G. Davey, who made biological tests of its potency, is completing a tour of Australia and India where he has been collecting the results of field trials.—*Lancet.*

The Arctic Institute of North America has reported progress in organization. In October 1945 the Institute opened its headquarters in Montreal, in quarters provided through the courtesy of McGill University. Since then the Institute has been incorporated as a non-profit-making organization in the United States under the laws of the State of New York and in Canada by Act of Parliament.

The Arctic Institute, an independent, private organization, is of international character and scope. It was financed initially by grants from the National Research Councils of Canada and the United States and by donations from private sources. During the organizational period it has seemed desirable to limit membership to the Board of Governors and the administrative staff, but the Constitution provides that a wider membership be contemplated in the near future.

At the present time the staff of the Institute consists of a small, full-time group headed by a Director with wide powers in conducting the affairs of the organization. Formulation of policy is in the hands of the Governors, chosen from among front-rank scientists and other individuals with administrative ability and interest in northern research and international scientific cooperation. The Governors serve without remuneration and meet with the Director at least three times a year to consider problems of administration and finance and to advise on the direction and coordination of research effort. They are elected triennially and serve in a personal capacity and not as representatives of the agencies, whether governmental or private, with which they are associated.

The present Board of Governors follows: Henri Bélanger, surveyor, Quebec City; Dr. Charles Camsell, commissioner of the Northwest Territories, Ottawa (past chairman); P. A. Chester, general manager, Hudson's Bay Company, Winnipeg; Dr. Henry B. Collins, Jr., director, Ethnogeographic Board, Smithsonian Institution, Washington, D. C.; Dr. Richard Foster Flint, professor of geology, Yale University, New Haven, Connecticut; Dr. L. M. Gould, president, Carleton College, Northfield, Minnesota (chairman); R. Gushue, chairman, Committee on Fishery Products, Combined Food Board, Washington, D. C., and St. John's, Newfoundland; Dr. Ernest M. Hopkins, president emeritus, Dartmouth College, Hanover, New Hampshire; Dr. Diamond Jenness, chief, Anthropological Division, National Museum of Canada, Ottawa; Dr. H. L. Keenleyside, Canadian Ambassador to Mexico, Mexico City, D. F.; Dr. C. J. Mackenzie, president, National Research Council of Canada, Ottawa; Dr. J. J. O'Neill, dean of the Faculty of Engineering, McGill University, Montreal (treasurer); G. R. Parkin, assistant treasurer, Sun Life Assurance Company of Canada, Montreal (secretary); Dr. Morten Porsild, director, Danish Arctic Research Station, Disko Island, Greenland; Walter S. Rogers, director, Institute of Current World Affairs, New York; Dr. Philip S. Smith, chief, Alaska Division, U. S. Geological Survey, Washington, D. C.; Dr. Vilhjalmur Stefansson, 67 Morton Street, New York; Dr. A. L. Washburn, director, The Arctic Institute of North America, Montreal; and Dr. J. T. Wilson, professor of geophysics, University of Toronto, Toronto (vice-chairman).

Organization of the Caribbean Research Council

Research in the Caribbean is old and has influenced the growth and development of these islands. The work done in the past, usually directed toward resolving a pressing problem rather than toward advancing fundamental knowledge, has been sponsored by universities and government agencies—rarely, by private organizations. There are some honorable exceptions, however, in which real contributions were made to the advancement of science, but the amount of research carried out in the various communities was highly dependent not so much on the needs of the territory but on the financial conditions or the initiative and enthusiasm of its people. The result, notwithstanding, has been considerable research activity in many fields of endeavor. Much of this has been of the highest quality in the larger territories, though very little, or almost none, has taken place in the smaller and less prosperous areas. The need for coordination and for the interchange of knowledge between the workers in these various areas is obvious.

With this in mind, and pursuant to the mandate creating the Anglo-American Caribbean Commission, a Research Council was established in August 1943, as a sort of advisory board to the Commission. Its main objectives were to survey the needs of these various communities and to recommend the research to be carried out in each; to arrange for the dissemination and exchange of the results of such research; to provide for conferences between research or extension workers; and to advise what further research and cooperation should be undertaken for the benefit of the people of the Caribbean.

A provisional committee was set up in August 1943 to function for the Council until all its members should be appointed. The committee was composed of Dr. Carlos E. Chardón, director of the Institute of Tropical Agriculture of Puerto Rico, Dr. Eric Englund, chief of the Regional Investigational Branch of the Foreign Office of Agricultural Relations of the U. S. Department of Agriculture (chairman), and Mr. A. J. Wakefield, C. M. G., inspector general of agriculture of the British West Indies. The provisional committee has organized the Council and set up its various technical research committees. These committees, established within the Council to deal with special groups or branches of research, were on (1) Agriculture, Nutrition, Fisheries, and Forestry; (2) Public Health and Medicine; (3) Industrial Technology; (4) Building and Engineering Technology; (5) Social Sciences.

The Council now consists of not less than 7, and not more than 15 persons, with not less than one representative from the five research committees. Selection of members is dependent on the scientific qualifications and attainments of the individual and, as far as practicable, on the necessity of insuring a balanced representation between the several sciences and the research organizations of the area. The chairmanship of the Council is a rotating one, held in turn for one year by a representative of each of the research committees. The respective chairmen of these last-named committees were appointed by the Commission during the first year, but thereafter the committees have elected their own chairmen. The activities of these committees are coordinated by the Council.

A Central Secretariat, with a full deputy chairman as executive officer of the Council, will be established, its functions being (1) to assist the Council and its research committees in planning lines of work and in formulating proposals for the conduct and coordination of research, and (2) to promote the implementation of such work and research as might be approved by the Commission.

Before recommending the implementation of new programs, the Council considers first the necessity for compiling all of the existing scientific data and of conducting surveys that will show the conditions existing in a given area. Since agriculture is the principal occupation in most of these countries, special attention has been given to this field by the Committee on Agriculture, Nutrition, Fisheries, and Forestry. Surveys are being made on sugar, livestock, grain crops, root crops and legumes, vegetables, grasses and grassland management, and coconut, copra, and oil seeds. Of these surveys, those on sugar production and livestock are the most advanced.

A Land Tenure Symposium was held in Puerto Rico from 27 August to 3 September 1944. A general analysis of this symposium is now being prepared, which will discuss the land tenure situation in the Caribbean and which may be utilized in the future in studying and planning similarly in the agricultural programs of other geographical areas.

A Forest Research Meeting was held at Trinidad, 14–23 January 1946. The meeting had before it statements on the present state of and existing facilities for, forest research in the various territories, and on this basis drew up detailed recommendations for the future.

The Medical and Public Health Section has been especially interested in standardizing maritime quarantine throughout this area, in compiling vital statistics of these regions, in surveys in the field of nutrition, and in promoting a Congress on Public Health and Tropical Medicine, where public health problems, common to all of these countries, may be analyzed and discussed.

In spite of the many handicaps and obstacles found on the way, the Caribbean Research Council has made some good progress during its first year of life. Progress is naturally slow in an organization of this nature, but whatever steps are taken should be thorough and as definite as circumstances will permit.

As far as we know, this is the first time that an international group has joined together to study the needs, and to plan the solution, of the sundry problems vital to any geographical area. The progress of the Council bears careful watching as an example of good will and of international cooperation. There is no doubt that in the future the Council will be of ever-increasing value to the peoples it serves and, indirectly, to many other regions of the world.—*P. Morales Otero* (School of Tropical Medicine, San Juan, Puerto Rico).

In the Laboratory

A Method for Determining Bacterial Resistance and Susceptibility to Sulfonamides and Penicillin

Roger D. Reid, Lt. Col., Sn.C., O.R.C., and
Dorothy Trotter Anderson
Eighth Service Command Laboratory, Fort Sam Houston, Texas

Wilson (*2*) has described a method for *in vitro* testing of the resistance of Group A hemolytic streptococci to sulfonamides. Although his technic has several advantages over earlier methods, the medium he describes is extremely complicated and the average laboratory does not have the materials at hand.

The necessity for routine determination of sulfonamide resistance or susceptibility of various pathogenic bacteria caused us to attempt a modification of Wilson's medium. The results we have obtained are entirely satisfactory, yet the test is extremely simple.

Our medium has the following composition: proteose peptone #3, 10 grams; dextrose, 5 grams; sodium chloride, 4 grams; agar agar, 4 grams; and distilled water, 1,000 ml. Other peptones and modifications may possibly be used without materially affecting the results.

The reaction of the medium is adjusted to pH 7.6–7.8 before sterilization and before the addition of the drug solution. The medium is dispensed in 90-ml. quantities, and to obtain approximately 10 mg. per cent concentration of the drug in the medium, 10 ml. of 100 mg. per cent solution of the drug are added. After mixing, the medium containing the drug is dispensed in 10-ml. amounts into 16-mm. culture tubes before sterilization in the autoclave at 15 pounds pressure for 15 minutes. The final concentration of the drug can be varied by addition of the proper amount of drug and making up to 100 ml. with more basic medium.

While our experience in testing sulfonamide resistance or susceptibility has been mostly with hemolytic streptococci which grow well in the basic medium, it has been observed that other bacteria grow well also. Growth of members of the *Neisseria* is supported, although the results obtained in testing the susceptibility of the gonococci to sulfonamides with this medium have not been as satisfactory as with streptococci. From results obtained it is obvious that the medium is satisfactory for the cultivation of the majority of pathogenic bacteria. Our experience with this medium has shown that there is little or no antagonistic effect upon the sulfonamides.

Penicillin has been added to this medium in various amounts, and the susceptibility of streptococci and other bacteria to this antibiotic has been determined by this method with satisfactory results.

In the earlier tests with this medium the sulfonamides were prepared in sterile, distilled water and added to the melted medium. No contamination resulted, but addition of the drug solution to tubes required accurate measurements of both medium and drug. This is time-consuming and tedious and tends to introduce errors. It was decided to add the drug solutions to the medium before sterilization and note the effect. Parallel tests using the same medium and drug concentrations sterilized by autoclaving with the medium or added without sterilizing showed no appreciable difference on the bacteriostatic effect of the drug. The concentration of the drug in the medium was determined before and after sterilization by the method of Bratton and Marshall (*1*) for blood sulfonamide determinations. There was slight, but not appreciable, reduction of sulfonamide concentration after sterilization (Table 1).

TABLE 1

Drug	In water	Not autoclaved	Autoclaved in medium
	mg. per cent	mg. per cent	mg. per cent
Sulfanilamide	11.4	9.4	9.2
Sodium sulfathiazole ..	11.7	9.1	9.0
Sodium sulfapyridine ..	11.0	9.1	8.9

The first dilution of drug is prepared in sterile, distilled water by placing 100 mg. of the drug into 100-ml. water. The next dilution is made by adding 1.0 ml. of the first dilution to 9.0 ml. of distilled water or 9.0 ml. of the medium. It will be noted (Table 1) that there is an immediate drop in sulfonamide concentration when the drug is added to the medium. Autoclaving the drug with the medium brings about another slight drop in drug concentration. These decreases may be allowed for by the addition of slight excess of drug when added to the medium. There is no further decrease in concentration upon incubation, and the medium may be stored for two weeks, or longer, without decrease in drug concentration.

It will be seen from a glance at Table 2 that there is no difference in the results obtained with media sterilized with and without the drug.

The control (+) contained approximately 20 colonies in each case. Where growth occurred in the presence of sulfonamide (Table 2) there were fewer than 20 colonies but sufficient growth to indicate resistance to 9.2 and 9.4 mg. per cent of drug. One colony appeared in medium containing 8.9 mg. per cent of sodium sulfapyridine after 48 hours' incubation. Culture 147 is, therefore, somewhat resistant to this drug.

TABLE 2

Drugs added after medium was sterilized	Concentration of drug mg. per cent	Cultures 089 MA		N 360 C 71		147	
		24	48	24	48	24	48
Sulfanilamide	9.4	+	+	–	–	+	+
Sodium sulfathiazole ..	9.1	–	–	–	–	–	–
Sodium sulfapyridine ..	9.1	–	–	–	–	–	–
Drugs sterilized in autoclave with medium							
Sulfanilamide	9.2	+	+	–	–	+	+
Sodium sulfathiazole ..	9.0	–	–	–	–	–	–
Sodium sulfapyridine ..	8.9	–	–	–	–	–	1 colony
Control	None	+	+	+	+	+	+

TABLE 3

Culture	Control		Sulfanilamide		Sodium sulfathiazole		Sodium sulfapyridine	
	24	48	24	48	24	48	24	48
1296	+	20 colonies	0	0	0	0	0	0
156	?	10 colonies	0	0	0	0	0	0
154	+	20 colonies	0	0	0	0	0	0
153	+	84 colonies	0	0	0	0	0	0
360	+	100 colonies	0	0	0	0	0	0
1172	?	2 colonies	?	6 colonies	0	0	0	6 colonies
1467	+	>100 colonies	+	>100 colonies	+	>100 colonies	+	>100 colonies
1060	+	35 colonies		30 colonies	0	0	?	20 colonies
147	+	+	0	0	0	0	0	0
089 MA	+	+	0	0	0	0	0	0

The convenience of preparing the medium containing the drug makes routine testing of sulfonamide resistance or susceptibility a simple matter, once the medium is prepared, amounting to no more than the inoculation of one more tube and a control tube. A series of tubes containing graduated amounts of the desired sulfonamide may be prepared. For this study a concentration of approximately 10 mg. per cent in the medium has been used and has been satisfactory in most cases for determination of drug resistance or susceptibility. Other concentrations of the drug have been used to determine degree of resistance.

Table 3 shows the results of a typical day of testing with hemolytic streptococcus cultures using 10 mg. per cent concentration of the sulfonamide indicated.

Usually results can be read after 24-hour incubation. Occasionally resistance to sulfonamide activity can be seen after 48-hour incubation and would be missed if read only in 24 hours. For this reason our results are read after 24- *and* 48-hour incubation.

Inoculation of the media for these tests is done by taking a loop of an 18- to 24-hour broth culture into a tube of tryptose-phosphate broth. One loop of this dilution into the melted (and cooled) semisolid medium containing the drug will generally give 10 to 20 colonies in the control tube. The loop that we have used measures 5.0 mm. in outside diameter and is made from 28-gauge platinum wire. The loop is flamed between each inoculation to remove traces of drug and agar and to keep the size of the inoculum as constant as possible.

While our particular interest in this problem has been to devise a simple and convenient method for testing sulfonamide resistance and susceptibility of hemolytic streptococci, the method can probably be used for testing other groups of organisms.

References

1. Bratton, A. C., and Marshall, E. K., Jr. *J. biol. Chem.*, 1939, 128, 537.
2. Wilson, Armin T. *Proc. Soc. exp. Biol. Med.*, 1945, 58, 130.

About the Chemical Nature of Syphilis Antigen

E. Fischer and F. Velasco

Cathedra of Anatomy and Physiology, Universidad de Chile, Santiago

In 1942 M. C. Pangborn (*3*) described a method of purifying the syphilis antigen of alcoholic beef heart extract by precipitating the phosphatides with $CdCl_2$, suspending the precipitate in petroleum ether, and eliminating the lecithin $CdCl_2$ complex by extractions with 80 per cent alcohol. The remaining solution contained cephalin $CdCl_2$ complex and antigen. After eliminating Cd by NH_3 and cephalin by precipitations with alcohol, the antigen was further purified until a substance which Pangborn claimed to be the pure syphilis antigen was obtained. According to this author this substance, called cardiolipin, is a new, nitrogen-free, sugar-containing phospholipid, with 4.11 per cent phosphorus.

In further publications (*4, 5*) Pangborn described another method of purifying the syphilis antigen, based on the precipitation of the cephalin fraction together with the antigen by $BaCl_2$ and eliminating cephalin by alcohol. After further purification a substance was obtained with the characteristics of syphilis antigen. This second "cardiolipin" contained no sugar but approximately the same amount of phosphorus as the "cardiolipin" of the first publication.

One of the authors and his co-workers elaborated between 1931 and 1936 (cf. *1*) several methods of purifying the syphilis antigen. Having applied two of these methods successively, a purified antigen preparation was obtained recently from the phosphatid fraction of alcoholic beef heart extract. The process of purification consisted of adsorbing the antigen on specially prepared aluminum hydroxide and eluting it in benzene. The antigen was then further purified by extracting it with petroleum ether from an acidulated 80 per cent alcohol solution. From 207 grams phosphatides 1 gram of a purified antigenic preparation was obtained, with only 0.01 per cent phosphorus, 0.25 per cent reducing substances (liberated by acid hydrolysis), and 40 per cent fatty acids (liberated by alkaline hydrolysis) (*1*).

It was shown in 1936 (*2*) that by extracting an 80 per cent alcoholic solution with petroleum ether, only a part of the antigen could be obtained in the petrol ether solution, another part still remaining in the hydroalcoholic phasis. Only after acidulating this phasis with HCl did the antigen disappear completely from it, entering into the petroleum ether phasis. We may assume, therefore, that the antigen occurs in two different forms in the alcoholic organ extract, *i.e.* acid and salt.

In recent experiments we have worked on the phosphatid fraction of 10 beef hearts, obtained by extraction with alcohol and precipitation with acetone. The antigen was absorbed on aluminum hydroxide and eluted in benzene. The substance obtained in this way was dissolved in 80 per cent alcohol and extracted at first without, and then with, acidulation.

We obtained in this way two fractions, which we shall call "petroleum ether fraction before acidulation" (P.E.N.) and "petroleum ether fraction after acidulation" (P.E.A.). Both fractions reacted with strongly positive sera. P.E.N. weighed 39 mg., and no phosphorus could be detected in it. P.E.A. amounted to 22 mg. with 0.1 per cent phosphorus. Both fractions were yellow oils which hardened rapidly, forming a transparent, soft film.

We assume that the small quantities of phosphorus found in our preparations correspond to impurities, as was the case with the reducing substances in our former experiment.

References

1. Fischer, E., Fischer-Dallmann, R., and Boné, R. *J. Immunol.*, in press.
2. Fischer, E., Steinert, J., and Fischer-Dallmann, R. *Z. Immunitäts.*, 1936, 89, 133.
3. Pangborn, M. C. *J. biol. Chem.*, 1942, 143, 247.
4. Pangborn, M. C. *J. biol. Chem.*, 1944, 153, 343.
5. Pangborn, M. C. *J. biol. Chem.*, 1945, 157, 691.

A Cheap and Speedy Method of Cleaning Old Microscope Slides

G. J. Spencer

Department of Zoology, University of British Columbia, Vancouver

For years our Department has been faced with the problem of cleaning off old microscope slides made with Canada balsam. None of the solvents used (xylene, toluene, turpentine, and coal oil) has proved effective in less than two weeks, and the resulting mass of dilute balsam, slides, cover slips and slide labels provided another problem in cleaning up.

Recently while collecting ectoparasites of mammals by the method recommended to me by Dr. G. H. E. Hopkins, of Uganda, which originated from Dr. F. L. Werneck, of Brazil, it occurred to me to try this upon microscope slides; it worked like a charm and is proving a boon in our laboratories.

Dr. Hopkins' method of recovering ectoparasites from fur is to place portions of hide into hot, 10-per cent caustic soda; the soda dissolves the hair and fur, and the sludge is then washed through fine, stainless steel mesh which retains the parasites. I have used this procedure extensively for parasite recovery, with considerable success, and now it is proving invaluable for cleaning slides. A number of methods can be employed, but I use three 500-cc. beakers, two of 10-per cent caustic soda on tripods over low Bunsen flames, and one spare. The caustic is kept at nearly boiling point, and a row of slides, held in a spiral of copper wire with the two ends sticking out straight, is placed across the top of the beaker so that the glass is immersed for most of its length. A large number of slides, from 1 to 13 years old have been tested and the speed of action timed; the latter varies inversely as the age and the amount of balsam present. In the case of old slides with thick balsam, the labels and cover slips slide off in from 23 to 30 seconds; in year-old slides with little balsam, it may take up to two minutes for the cover slips to fall off. All slides made with very little balsam, irrespective of age, take longer than those with much balsam. The size of cover slip does not affect the speed of action.

24 × 50-mm. rectangles come off as fast or even faster than 18-mm. circles unless the long ones are overlapped by a label which is not entirely immersed in the caustic.

The slides must not be in contact or else the hot caustic cannot penetrate between them. If any cover slip does not drop off in two minutes, it can readily be shoved off with the edge of a slide.

When all cover slips and labels have fallen off, the beaker is left over the flame for about a minute or two longer, the slides are released from the spiral, the caustic soda is poured off into the spare beaker, and another set of slides in a holder is set to soak. In the meantime the beaker with slides and cover slips is held under a gentle flow of hot water in the sink. The hot caustic soda apparently saponifies the esters in the Canada balsam, and the hot water washes it all away, leaving both slides and cover slips beautifully clean. If any balsam remains adhering to the glass, it can usually be washed off between thumb and finger under the tap; occasionally an obstinate one must be dropped back into the hot caustic to soak.

By the time one has carefully washed 10 slides and their cover slips between thumb and finger under the tap and dried and boxed them, the next series of 10 is ready for washing. It is therefore unnecessary to have a larger setup.

A more convenient method than the one outlined above, would be to have a wire-gauze box of copper or stainless steel with a spiral or slotted holder on top, so that the whole thing could be suspended in a large beaker of caustic and the box and its contents lifted out instead of having to pour the alkali from one beaker to another. In the method just described, additional caustic solution has to be added from time to time to the beaker over the flame to make up for the amount washed away under the tap. This periodic addition of new solution seems to keep up the effectiveness of the hot bath, which does not become saturated and therefore impotent until many slides have been cleaned.

Solutions of 10, 15 and 20 per cent have been tried. The 10-per cent solution seems to work as well as the stronger ones. Leaving slides to soak overnight, or even for days, in cold caustic is quite ineffective and seems to render the balsam somewhat resistant to saponification when the slides are finally placed in a hot solution.

Letters to the Editor

Sources of Our Future Scientists

Vannevar Bush, Director of OSRD, has estimated in his recent report to the President (*Science, the endless frontier*) that the deficit of those who would have received a bachelor's degree in science or technology had reached 150,000, and that by 1955 there would be a loss of 17,000 who would otherwise have been given advanced degrees.

There is, however, one important element in the supply of future scientists which he did not consider. This is the source of the hereditary material, the necessary biological counterpart of the favorable educational environment which he discusses. All recent studies of this indispensable prerequisite for future scientists are alarming, indicating as they do that for the past century our most educated groups have failed to bear enough children to replace themselves. These studies have, of necessity, been based upon the ability to acquire a given amount of education, usually that represented by a college degree. For economic reasons, this test does not include all who might have become graduates, but it does indicate an intelligence level well above that of the average in the country. While there will obviously be exceptions, it seems fair to assume that the average scientific ability of the offspring will also be high, and that the surroundings and mental stimulation to which these children will be exposed will be favorable for the production of scientists.

While graduates of Yale in the early 1700's had averaged about 5 surviving children each, this record steadily decreased. For the classes graduating about 1825, 3.5 children were born to each graduate; for those graduating in the decade from 1870 to 1880 from Harvard, Wesleyan, Syracuse, and Yale, the children were well below the number necessary for replacement. For the Harvard classes of the 1890's, they had fallen to 1.45 per graduate. To secure later information, the writer has made a study of the five most recent Harvard classes to have issued their 25-year reports (The deficit in the birthrate of college graduates. *Hum. Fertility*, in press). These give statistics collected at a time when their families are nearly complete. A more favorable trend was found, with 1.67 children per graduate, but the offspring are still distinctly below the replacement level. Furthermore, it may be only a transient increase, since reports of the classes of 1931 and 1936 disclose that in the early years after graduation, their children were only 77 and 62 per cent of the per-capita rates of 1916 to 1920 for the same periods.

Ominous figures are also found in the recently published volume of the U. S. Census Bureau (*Population, differential fertility 1940 and 1910, women by number of children ever born.* 1945). Women included in the 1940 census, aged 45 to 49 and with less than 4 years of schooling, reported an average of more than 4 children each. As the amount of education increased, this number fell until for high school and college graduates it was 1.75 and 1.23, only 77 and 55 per cent of the number of children necessary for the replacement of the parents. The Census Bureau estimates that for one son per father (or daughter per mother) to survive to the age at which his father (or her mother) was enumerated, 2.22 children must be born. With the better than average care given by college graduates, the number is somewhat less than this for that group.

To determine the extent of this loss of an important national resource, a study of the numbers of children born to the graduates of other colleges seems of value. The Population Reference Bureau, 1507 M St., N.W., Washington 5, D. C., has, therefore, planned a nationwide intercollegiate comparison of these birth rates. Questionnaires have been offered without charge to those wishing to assemble the needed information from the classes of 1921 and 1936, the twenty-fifth and tenth reunion classes. The earlier class was chosen because few children are to be expected after this date; the later class, to indicate the more recent trend.

Sixty-six colleges, with about 26,000 students in these two classes, have asked for the questionnaires. The results should give valuable information regarding the sources from which our future scientists may be expected, and the degree to which our present educated groups are replacing or failing to replace themselves.

Clarence J. Gamble, M.D.

255 Adams Street, Milton, Massachusetts

B-Glycoside Formation in Plants From Absorbed Chemicals

The letter by E. G. Beinhart (*Science*, 1946, 103, 207–208) with reference to the absorption of the vapors of phenols by plants is of interest in calling attention to the relative ease with which absorption and retention of non-naturally-occurring organic compounds may take place. Experiments conducted several years ago by the writer (see, for example, *Science*, 1940, 92, 42–43, and *Contr. Boyce Thompson Inst.*, 1943, 13, 185–200) showed that various chemicals containing an alcoholic or phenolin hydroxyl group were readily absorbed from nutrient solutions (and in several cases, inadvertently from vapor in the air) and combined within the plant with sugars to form β-glycosides. Such a biosynthesis of glycosides seems to take place quite generally among higher plants, and it appears likely that the phenols with which Beinhart's article is concerned were fixed within the plants as β-glycosides. This would explain the persistence of the flavor and the lack of off-flavors in the root crops (carrots, beets, and potatoes), since these glycosides do not seem to move readily from one organ of the plant to another.

In view of the stability of these β-glycosides within the plant it follows that the presence of relatively small amounts of chemical in the air over a long period of time could result in the building up of appreciable concentrations of foreign β-glycosides in the edible portions of plants. The hazard is thus much greater with chemicals that undergo this or similar reactions than with those that are not fixed by the growing plants.

Lawrence P. Miller

Boyce Thompson Institute for Plant Research, Inc.
Yonkers 3, New York

On Recognition of High School Science Training

Charles A. Gramet's letter on High School Science (*Science*, 1946, 103, 149) brings up a point on which I can report two observations, one personal and one professional, but both illustrative of the serious influence which the college attitude toward high school science has on a student's planning of his academic work and his preparation for gainful employment.

In 1916, when I was 12 years old, my father followed the rather unusual expedient of arranging for me to spend a summer term studying chemistry in company with a friend of the same age. At the conclusion of this term our instructor informed our parents and the school authorities that we had quite satisfactorily completed the equivalent of a rather stiff first term of senior high school, or first year college, chemistry.

Later, because I was interested and did not mind the duplication of the first term of work, I took a full year of chemistry in my senior year at East High School, Rochester. With no further training in chemistry I carried out some work in my father's anatomical laboratory which required careful chemical manipulation; I held a job for nine months as an assistant to a photochemist in the Eastman Kodak Research laboratory; and I later did considerable writing on subjects which required some basic knowledge of chemistry.

Obviously, I was interested in chemistry. I considered certain college courses permitting advanced work in chemistry, but in two instances I met with an absolute refusal by colleges to accept this excellent preparatory training as an equivalent of first year college chemistry. A similar experience took place in relation to biology. After a boyhood and youth spent in close contact with the various Ward family activities in anatomy and the biological sciences, and a year of an excellent senior high school biology course, my college would not give credit for senior high school biology and I took first year college biology. It differed little from the high school course and, in essence, was so much waste motion.

I have just gone back to some of my letters, written in first year college in 1922, and I find that the need to "repeat chemistry and biology" was a constant consideration which led me to make some rather drastic changes in my college plans and to swing over to journalism and sociology. This was not a student whim; it was a carefully considered reaction to the waste of time and boredom of repeating high school science courses.

In the period since 1934, when I have been working as a vocational counselor for out-of-school youth and adults and have been teaching other counselors engaged in this work, I have time and time again encountered young men and women who have been quite needlessly forced to undergo the drudgery of repeating their high school chemistry and/or biology in the first year of college, or have been influenced to make very drastic changes in their education-vocational plans by this regulation.

I do not think that I need to stress, in this enlightened age, that the motivation of interest is probably the most potent force we can arouse in the classroom. I also think that many thoughtful educators will not lightly dismiss youthful disinclination to repeat science courses—it smacks of the Middle Ages to talk of "discipline" as an excuse for enforcing monotonous repetition.

It might also be suggested that in many senior high schools the size of classes and the quality of teaching is superior to the overcrowded classrooms and laboratories and the routine type of instruction found in many first year college science courses.

It is granted that some standards are needed. High school science instruction, in chemistry, physics, and biology, varies a great deal in various states. However, if the college science faculties and committees on admissions can bring themselves to evaluate the quality of science teaching in various states and even in various municipalities within states, they can eliminate a practice which experienced vocational counselors can testify is either driving students to abandon plans for scientific work or exposing them to an educational ordeal which is inclined to cause youthful doubt as to whether education really lives up to the enlightened claims in which it is so prone to indulge.

I am not prepared to agree that college admissions authorities should "require" a two- or three-year high school science sequence as a prerequisite to college admission. College admission requirements are inflexible enough as it is, but it is reasonable to suggest that college science faculties give the same recognition to high school science work, in well-conducted courses in chemistry, physics, and biology, as is given by language and mathematics faculties to high school work in those fields.

This encouragement of high-quality work in chemistry, physics, and biology in high school, rather than the science survey courses, will also assure that high school students who do not go to college will have some adequate knowledge of scientific progress and problems, useful either in their future orientation in business or in the skilled trades.

ROSWELL WARD

School of Education, New York University

Recent Additions to the Dudley Herbarium

By the terms of the will of the late Dr. L. Herman Knoche, of San Jose, California, Stanford University has received his entire herbarium and botanical library. The herbarium specimens and the famous collection of botanical reprints assembled by Adolph Engler have been moved into the quarters of the Dudley Herbarium and are already available for use by qualified graduate students enrolled at Stanford, by the staff, and by other investigators interested in taxonomy, ecology, and geographical distribution of plants.

The bulk of Dr. Knoche's herbarium (totaling over 125,000 sheets of dried specimens) was accumulated by Gaston Gautier and consists, for the most part, of specimens collected in southern Europe and other areas adjacent to the Mediterranean Sea. This collection contains a large number of specimens cited by various European authors and is very valuable to botanists of the Western Hemisphere who wish to study authentic material from southern Europe and northern Africa. A few scattered specimens from other parts of the world are also included, but these are decidedly in the minority. None of these specimens is mounted, all of them being laid between sheets of thin paper, the labels being tucked under the stems or leaves of specimens to which they apply. In most cases only one collection is represented on a sheet, but in a few cases two separate accessions have been placed in the same double sheet. Those that have thus far been examined are quite distinct in appearance when two are on the same sheet, so no serious difficulty is anticipated in separating them and getting them segregated onto individual herbarium sheets. The bundles are arranged systematically, and any desired family or genus can be extracted readily for study.

Engler's collection of reprints covers several broad fields in botany in addition to strictly taxonomic treatments of vascular plants. Sections of it deal with geographical distribution, ecology, plant physiology, morphology, floristic studies of various regions, and small sections on algae, fungi, mosses, liverworts, and ferns. The taxonomic parts were arranged according to families, following the Engler and Prantl system, and have been kept in the same order in which they were classified by Engler himself. Many of the folders in which loose reprints are tied still bear the labels written in Engler's hand. The collection contains over 25,000 separates.

The library of bound botanical books is rich in floras from many parts of the world and contains a number of comparatively rare works not generally available in the libraries of the western United States. This portion of Dr. Knoche's library has not yet been catalogued and placed at the command of the botanists working on the Stanford campus, but it is hoped that this task will go forward steadily and that the entire library will be available for use within a few months.

IRA L. WIGGINS

Stanford University

New Use for DDT

"Scab mites" (*Psoroptes cuniculi*) often cause extensive scab formation in the ears of laboratory rabbits. These mites do not burrow beneath the skin, but remain on the surface, where they may cause sufficient irritation to produce a many-layered scab in which they may be present in large numbers.

We have found that the application of a 5-per cent solution of DDT by an ordinary nebulizer to the inner surface of the ear of the rabbit affords a simple, nontoxic method of curing this condition. When the scabs are many layered, it may be necessary to make several applications of DDT at three-day intervals in order to reach the more deeply situated parasites. The destruction of the parasites is followed rapidly by the healing of the affected surface. A single application is useful in the prophylaxis of exposed animals.

ERNST T. KREBS, JR.
Division of Anatomy
University of California Medical School, San Francisco

Book Reviews

Photosynthesis and related processes. **Vol. I: *Chemistry of photosynthesis, chemosynthesis and related processes in vitro and in vivo.* Eugene I. Rabinowitch. New York: Interscience Publishers, 1945. Pp. xiv + 599. (Illustrated.) $8.50.**

In the last 25 years our knowledge about photosynthesis has undergone a luxuriant growth. At the beginning of this period Stiles and Spoehr each summed up the available data in monographic form. Since then information has merely accumulated; and while there have been efforts to weed and cultivate small sections, the field as a whole has not had the intensive examination and harvesting it has needed and deserved.

The task is formidable; its extent is indicated by the fact that the present book is only the first of a pair planned to cover the subject. This volume deals with the chemical phases of photosynthesis, while its promised successor is to treat the physical aspects.

The book contains 20 chapters. The first two are introductory and place the subject in its scientific and historical setting. The next eleven chapters take up the photosynthesis reaction as a whole, its products, related reactions outside the cell, chemosynthesis by bacteria, the photochemical reactions, the nonphotochemical reactions, and the effects of outside chemical agents. The seven chapters that follow describe the pigments involved in photosynthesis, their structure, chemistry, and photochemistry. A final chapter covers the relations between photosynthesis and respiration.

There is a large number of original diagrams, tables, and figures. Also, there are excellent author and subject indexes. Each chapter ends with a bibliography arranged historically. A rough count adds up to about 2,000 titles.

The treatment of this extensive material is fresh and tough-minded. Every contribution to photosynthesis and the related subjects has been read and evaluated, and is given a presentation which is just and rigorous.

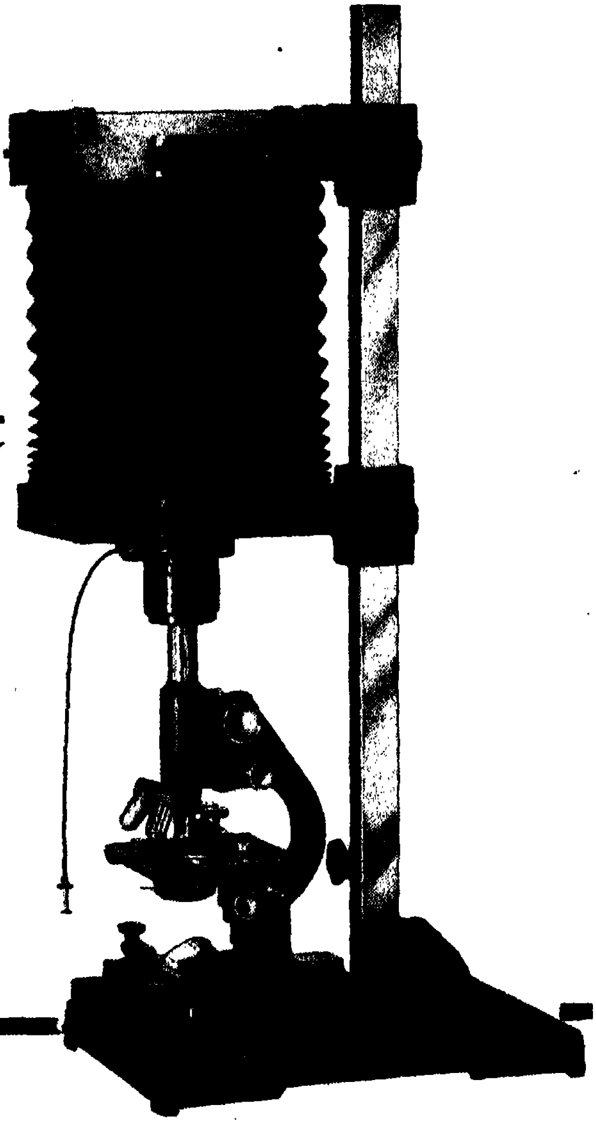
The book, however, is no pedestrian account of work accomplished. The first chapter is beautifully written; it has a magnificence of conception that carries one along breathlessly. Similarly, Chapter II, which describes the discovery of the basic phenomena of photosynthesis, maintains a fine balance between large issues and detailed data and gives one a sense of participating in the high adventure of scientific discovery. Even Chapter III, which has no historical structure, is fascinating reading because of the sheer intellectual power of its analytical procedure.

Naturally, such an exciting level of writing cannot be maintained, and the price which has to be paid for the patient, inclusive, and critical presentation of so large a collection of material is an absence of the dramatic power of an historical narrative. Since one does not ordinarily find this in a scientific monograph, we may gratefully accept these first three chapters as the *hors d'oeuvre* of a nourishing meal furnished by the rest of the book. The chapters which follow are not just to be read; they need to be studied. And for this too we are grateful. We need the careful and detailed discussion of all this wealth of data for the edification of scholars in this field and for the instruction of those just entering it. Dr. Rabinowitch is to be congratulated on the high level which he has maintained in working over this staggering mass of information.

With so much excellence already received, it may seem ungracious to ask for something else. Yet one wishes that Rabinowitch had not divided the subject into the obvious chemical and physical volumes. Photosynthesis is all of a piece; its division into physics and chemistry is artificial and produces difficulties which are apparent even to the author. Perhaps the situation will be improved when the physical companion volume appears, so that one can easily refer from one volume to the other.

Also, one misses a chapter or two in which the larger outlines of the subject are delineated. The same boldness, which in Chapter II omitted details in order to bring out the essential features of photosynthesis as recognized in the early days, could have been used to paint a broadly conceived picture of the essentials of today. One would like to see in sharp relief such concepts as the light and dark reactions, quantum efficiency, limiting factors, the effect of light intensity and of intermittent illumination, so that the reader might have clearly before him the large masses of the composition before he stops to examine the details which enrich and enliven the separate parts.

Nevertheless, even the elaborate and detailed presen-



Bausch & Lomb
Photomicrographic
Camera

Type H

Adaptability to a wide range of needs makes the Bausch & Lomb Type H Camera one of the most valuable of small cameras for photomicrographic work. Utilizing any standard microscope it may be used in either a vertical or horizontal position. In the vertical position the bellows may be extended to 20″; in the horizontal position to 24″. For gross photography a Micro Tessar with rack and pinion focusing mount may be mounted on the front board. The large cast base is sufficiently heavy to balance the camera in the fully extended horizontal position. For complete information send for Catalog E-21. Bausch & Lomb Optical Co., 642-4 St. Paul Street, Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

tation has its virtues. For example, we cannot but become impressed with the relation of photosynthesis to other biological activities which build organic compounds by reducing carbon dioxide. Some plants require light but use H_2S as a reductant instead of H_2O. Others do not even require radiation, but rely on the energy they get from simple organic substances. The pattern is the same, but the specific means vary. This hierarchy of CO_2 reduction processes may help us imagine the origin and development of photosynthesis. It shows us simpler systems which could have furnished energy for life before the invention of chlorophyll, a substance which is high in the structural scale and needs living tissue for its manufacture.

This is a great book, which will serve for many years as *the* source book of critically digested information about photosynthesis. It is to be hoped that Rabinowitch will not keep us waiting too long for the second volume and that, having acquired all this erudition about photosynthesis, he will take his learning lightly and write a small book for the uninitiated so that the general scientific public may profit from his prodigious labors.

SELIG HECHT

Columbia University

Sampling statistics and applications: fundamentals of the theory of statistics. James G. Smith and Acheson J. Duncan. New York and London: McGraw-Hill, 1945. Pp. xii + 498. (Illustrated.) $4.00.

This volume is a very well-presented combination of advanced statistical method and both elementary and advanced sampling theory. It is intended for advanced students and research workers and is gauged at a level which makes a thorough knowledge of elementary statistics a prerequisite to its enjoyment and comprehension. However, granted a thorough training in the elements of statistics, basic concepts and definitions in advanced theory are clearly presented. Symbols are well defined, and the scope of mathematical treatment is chosen in a manner which makes the volume very valuable as a text and as a reference book.

After the general theory of frequency curves has been discussed, the theory of random sampling is presented in Part II, proceeding to an advanced exposition in Part III. Parts II and III deal with important sampling considerations not usually found in statistical texts. The advantages and necessities of random sampling are discussed, and a very careful treatment of the practical difficulties encountered in the use of random sampling is included. In this connection the authors explain why it must be admitted "that confidence in an inference based on a random sample is dependent on the 'thought' or firm belief that it is a truly random sample. Whether thought with respect to randomness is any sounder, as a basis for inferences, than thought with respect to representativeness of a sample obtained by some other method is a debatable question." Recent conflict of theory among experts indicates the vital significance of this consideration.

A portion of the section devoted to elementary sampling theory discusses the value of stratified or representative random sampling. The authors point out the value of stratification when it is based on correlates with the survey objective. They recognize a reduction in error when proper representation is achieved: "The significance of stratified or representative random samples is that it reduces sampling errors."

Sampling is discussed in relation to the assembly of evidence and also in relation to the estimation of population parameters. This allows an extension of the theory to our ordinary statistical conceptions of reliability and confidence. The boundaries of statistical inference are defined, and examples of their application are given.

RAYMOND FRANZEN

10 Rockefeller Plaza, New York City

The bacterial cell. René J. Dubos (with an addendum by C. F. Robinow). Cambridge, Mass.: Harvard Univ. Press, 1945. Pp. xix + 460. (Illustrated.) $5.00.

This thought-provoking discussion integrates our knowledge of the biological and chemical architecture of bacteria with the classical techniques of cytology and interprets some of the phenomena of the infectious process in terms of the biochemical architecture of the bacterial cell. The author makes the point in his Preface that "in addition to physicochemical properties shared by all living forms, each bacterial type possesses a structural and biochemical individuality which could serve as a basis for an orderly statement of the problems of cellular organization, and for a rational system of classification based on phylogeny." Known facts, however, are too few for convincing integration and generalization—thus a plea for more fundamental investigations in the field of bacterial physiology.

The volume is the outgrowth of a course of eight lectures delivered under the auspices of the Lowell Institute in Boston. The chapter titles are important enough to note: "Materials, Problems and Methods," "Cytology of Bacteria," "Physicochemical and Staining Properties of Bacteria," "Analysis of Cellular Structure by Biochemical and Biological Methods," "The Variability of Bacteria," "The Nature of Virulence," "Immunization Against Bacterial Infection," "Bacteriostatic and Bactericidal Agents," and "Trends and Perspectives." The addendum is entitled "Nuclear Apparatus and Cell Structure of Rod-shaped Bacteria."

The author discusses the many controversial questions impartially and with credit to the protagonists of both sides. Where final conclusions are unwise, they are not made by the author.

The author's statement, "Even among the Eubacteriales—the so-called true bacteria—one finds strange bedfellows, such as small Gram-negative autotrophic organisms, the Gram-positive proteolytic spore formers, acid-fast bacilli, which differ so profoundly from each other in metabolism, structure and even mode of division as to have little in common except microscopic dimensions,'' should engender lively discussion. Perhaps ''the methods employed by bacteriologists rather than the biological material'' are defined by the microscopic size of the bacteria which impose certain physical and chemical characteristics, rather than the biological material.

In speaking of the phylogeny of bacteria, if we accept with the author the principle of ''retrograde evolution by loss of certain characters,'' one may beg the question in reasoning that heterotrophs preceded autotrophs. The latter possess so many physiological abilities, e.g. formation of vitamins and enzymes, that the argument works both ways, and no conclusion is reached. Apparently we have not determined what are the essential losses which constitute ''retrograde evolution'' or ''loss variation.''

Until the Twentieth Century bacteriology was a science of new forms of life without much regard to activities. The great productivity era in bacteriology came with the realization that bacteriological phenomena constitute events of great importance to man—transformation of organic matter and parasitism. During the past few decades the problems of bacteriology have been stated in terms of the classical sciences and of the prevalent biological, physiological, and biochemical philosophies. Dubos points out that much of our theoretical knowledge was a by-product of the solution of practical problems by empirical methods, and examples are given of the practical advantage of theoretical knowledge, e.g. development of vaccines, therapeutic sera.

Bacterial specificity is discussed from the point of view of its various levels, *i.e.* strain, species, genus, etc., and of its type, *i.e.* immunologic, enzymic, structural, or biochemical.

The author points out that a too narrow interpretation of the dogma of the fixity of bacterial species led to a neglect for nearly 50 years of one of the most intriguing and important characteristic properties of the bacterial cell, namely, its ability to undergo environmental and hereditary transformations. Final recognition of this phenomenon suggested powerful and original techniques for the study of cellular organization and provided new points of view which define the place of bacteriology among the biological sciences.

Pertinent to the systematic chaos occurring in the classification of bacteria is the statement to the effect that in the description of bacterial groups (e.g. species) descriptive characters are used which are precisely those that have been found to undergo variation. It seems likely that the progress of bacterial taxonomy and the study of evolutionary trends among bacteria will require that cultures be described in terms of their multiple potentialities and not of an accidental phenotype.

The chapters are well organized and interestingly written. The reviewer appreciated particularly the author's discussions of bacterial variability (Chap. V) and bacteriostatic agents (Chap. VIII). This book is essential to bacteriologists, biochemists, and biologists.

O. H. WERKMAN

Iowa State College, Ames, Iowa

THE NEWEST TITLES IN

The Princeton Mathematical Series

THEORY OF LIE GROUPS

By Claude Chevalley

The first volume of a two-volume work which aims at a systematic treatment of the theory of Lie groups, taking into account the shift of emphasis from the local to the global point of view which is the main feature of modern research in the subject.

CONTENTS: Definition of the classical linear groups. Theory of topological groups and their covering groups. Definition of a manifold and related notions. Definition and general properties of Lie groups. An exposition of the differential calculus of exterior forms. Theory of compact Lie groups and their representations.

No. 8 in Princeton Mathematical Series.
6" x 9". 224 pages. Just published. $3.00

INTEGRATION

By Edward J. McShane

This book was written in the hope that it would provide a fairly easy path leading advanced students of mathematics into the theories of integration which underlie much of modern analysis.

The method of the development of the theory is a modification of that devised by Daniell, the Lebesgue integral appearing as the result of a two-stage extension of the classical integral of a continuous function. The proofs are so arranged that the Lebesgue-Stieltjes integral is obtained with little additional discussion. The Perron integral is also studied. Ordinary differential equations are treated in considerable detail, in order that the theorems obtained shall be suited to the needs of the Calculus of Variations.

No. 7 in Princeton Mathematical Series.
6" x 9". 400 pages. 1944. $6.00

AT YOUR BOOKSTORE,
Princeton
UNIVERSITY PRESS

Scientific Book Register

Aberg, Ewert. *Studies of crop production in the United States 1940 to 1943.* Uppsala, Sweden: Almqvist and Wiksells Boktryckeri AB, 1944. Pp. 86. (Illustrated.)

Beet, Ernest Agar. *A text book of elementary astronomy.* Cambridge: at the Univ. Press, 1945. Pp. x + 110. (Illustrated.) $2.00.

Bourgouin, Louis. *Histoire des sciences et de leurs applications.* Montreal: Editions de L'Arbre. Pp. 326. (Illustrated.)

Brues, Charles T. *Insect dietary: an account of the food habits of insects.* Cambridge, Mass.: Harvard Univ. Press, 1946. Pp. xxvi + 466. (Illustrated.) $5.00.

Brunschwig, Alexander, *et al.* *Cancer; what the public should know; a radio discussion.* (Transcript No. 403.) Chicago: Univ. Chicago Round Table, 1945. Pp. 17. $.10.

Burton, E. F., and Kohl, W. H. *The electron microscope: an introduction to its fundamental principles and applications.* (2nd ed.) New York: Reinhold, 1946. Pp. 325. (Illustrated.) $4.00.

Bush, Vannevar. *Endless horizons.* Washington, D. C.: Public Affairs Press, 1946. Pp. ix + 182. $2.50.

Clark, Bruce L., and Durham, J. Wyatt. *Eocene faunas from the department of Bolivar Colombia.* (Geol. Soc. Amer., Mem. 16.) Baltimore: Waverly Press, 1946. Pp. vi + 126. (Illustrated.)

Cohn, Alfred E. *Minerva's progress: tradition and dissent in American culture.* New York: Harcourt, Brace, 1946. Pp. viii + 101. $2.00.

Cole, Fay-Cooper. *The peoples of Malaysia.* (2nd printing.) New York: D. Van Nostrand, 1945. Pp. xiv + 354. (Illustrated.) $4.00.

Coolidge, Julian Lowell. *A history of the conic sections and quadric surfaces.* Oxford, Engl.: Clarendon Press, 1945. Pp. xi + 214. $6.00.

Dunlap, Orrin Elmer, Jr. *Radar; what radar is and how it works.* New York: Harper, 1946. Pp. 222. (Illustrated.) $2.50.

Fowler, Willis M. *Hematology for students and practitioners.* New York-London: Paul B. Hoeber, 1945. Pp. viii + 499. (Illustrated.) $8.00.

Gautheret, R. J. *La culture des tissus: une voie nouvelle en biologie végétale.* (L'Avenir de la Science—21.) France: Librairie Gallimard, 1945. Pp. 203. (Illustrated.) 190 fr.

Goldzieher, Max A. *The endocrine glands.* New York: Rudolf Schick, 1945. Pp. 49. (Illustrated.) Textbook, $1.20; charts, $6.50 each.

Grant, Julius. (Ed.) *Hackh's chemical dictionary: American and British usage.* (3rd ed.) Philadelphia-Toronto: Blakiston, 1946. Pp. xii + 925. (Illustrated.) $8.50.

Hayes, John E. R. *The nature of patentable invention: its attributes and definition.* Cambridge, Mass.: Addison-Wesley Press, 1945. Pp. vi + 183. $5.00.

Herrick, Arthur D. *New drugs.* New York: Revere Publishing Co., 1946. Pp. xiv + 303. $4.00.

Hirsch, A. A. *Manual for water plant operators.* Brooklyn, N. Y.: Chemical Publishing Co., 1945. Pp. 403. (Illustrated.) $6.50.

Kennedy, Raymond. *Bibliography of Indonesian peoples and cultures.* (Yale Anthrop. Stud., Vol. 4.) New Haven, Conn.: Yale Univ. Press, 1945. Pp. 212. (Illustrated.) $2.50.

Murrill, William Alphonso. *Reptiles good and bad.* Gainesville, Fla.: Univ. Florida, 1945. Pp. 32. (Illustrated.) $2.00.

Murrill, William Alphonso. *Rocks.* Gainesville, Fla.: W. A. Murrill, 1946. Pp. 62.

Rapaport, David. *Diagnostic psychological testing.* (Vol. 1.) Chicago: Year Book Publishers, 1945. Pp. 573. (Illustrated.) $6.50.

Rider, John F. *Inside the vacuum tube.* New York: John F. Rider, 1945. Pp. xvi + 407. (Illustrated.) $4.50.

Smillie, Wilson G. *Preventive medicine and public health.* New York: Macmillan, 1946. Pp. xvi + 607. (Illustrated.) $6.00.

Smith, Bruce Lannes, Lasswell, Harold D., and Casey, Ralph D. *Propaganda, communication, and public opinion: a comprehensive reference guide.* Princeton: Princeton Univ. Press, 1946. Pp. ix + 435. $5.00.

Spurr, J. E. *Geology applied to selenology.* I: The Imbrian Plain region of the moon (2nd printing); II: The features of the moon. Lancaster, Pa.: Science Press, 1945. I—Pp. x + 112; II—Pp. xiii + 318. (Illustrated.) $5.00.

Steacie, E. W. R. *Atomic and free radical reactions: the kinetics of gas-phase reactions involving atoms and organic radicals.* (Amer. Chem. Soc. Monogr. Ser.) New York: Reinhold, 1946. Pp. vii + 548. $8.00.

Theilheimer, W. *Synthetische Methoden der organischen Chemie.* (Repertorium, Vol. I.) New York-Basel: S. Karger, 1946. Pp. viii + 224. Fr.s. 25.

Wells, A. F. *Structural inorganic chemistry.* Oxford: Clarendon Press, 1945. Pp. viii + 590. (Illustrated.) $7.50.

ZoBell, Claude E. *Marine microbiology: a monograph on hydrobacteriology.* Waltham, Mass.: Chronica Botanica, 1946. Pp. xv + 240. $5.00.

SCIENCE

Vol. 103, No. 2677 Friday, April 19, 1946

War on Weeds

E. M. Hildebrand

Research Department, Food Machinery Corporation, Dunedin, Florida

MORE WORK ON HERBICIDES and more in the way of scientific and practical achievement with herbicides has taken place in the past decade than at any time in history. No doubt the urgent need for increased food production, coupled with the drastic shortage of farm labor, stimulated interest in weed control.

SIGNIFICANCE OF HERBICIDES

A weed (*18*) may be defined as an undesirable plant or "a plant out of place." Weeds compete for a place in the sun by occupying space. They also compete for soil nutrients and thereby reduce not only the yield but also the quality of farm crops. Both woody and herbaceous plants may be weeds, and they can cause losses in many and devious ways. Most virus diseases of plants are spread by insects and in every known case weeds serve as hosts for the insect vector and may also harbor the virus pathogen. Many fungus and bacterial diseases of plants overwinter on, or are harbored by, weeds (e.g. downy mildew of lettuce winters on wild sunflower and thistles). Economic insects are frequently harbored on weeds, where the weed fits into the insect's life cycle (cotton aphid, potato flea beetle, red spider). The winter phases of the life cycles of the leaf hopper insects, which carry curly-top virus to sugar beets and yellow blight to tomatoes in California, are spent mainly on thistles. Weed control will become more and more important as more is known about the disease and insect pests of farm crops.

Weeds function as an unseen tax on the crop harvest. For example, it is estimated that losses from weeds in California total about $60,000,000 annually. According to Taylor (*25*), weeds rob farmers in the United States of $3,000,000,000 a year. From this, the economic importance of weed control cannot be questioned. The weeding operation, especially where vegetables like onions and carrots are concerned, can comprise 30 per cent of the cost of production. The hand labor involved in the first weeding of onions and carrots is always very tedious, requiring adequate, careful, and timely work costing about $30 an acre. Here an inexpensive, rapid method of killing weeds is needed.

Certain weeds are so efficient as competitors of the food and forage crops that they have thwarted the efforts of man to control them by any means. These weeds are called "noxious," and it is of interest to know that most of the noxious weeds (Canada thistle, sow thistle, Russian thistle, artichoke thistle, wild mustard, Russian knapweed, corn cockle (?), English plantain, wild oats, wild morning-glory, quack grass, etc.) are aliens or exotic. The water hyacinth which now clogs the fresh-water streams and lakes in subtropical America originally came from Japan.

Many weeds persist for long periods of time in the soil when buried in the plowing operation. Each cultivation usually starts off a new crop of weeds. While there are numerous species (annual, biennial, or perennial in habit), only a relatively few are of serious economic importance for any one crop. Annuals, in passing through their complete cycle back to seed in one season, are vulnerable to herbicides, especially when small. For the perennials the situation is different because the herbicide must be capable of reaching and killing the underground parts if it is to be successful.

The importance of weed control led several years ago to the organization of the Western Weed Control Conference, consisting of all weed-control officials in 11 Pacific slope states. Recently, a North Central States Weed Control Conference, composed of 13 states, was organized. Its research committee has suggested a uniform plan of experimentation on 2,4-dichlorophenoxyacetic acid (2,4-D) for 1946 based on the 1945 program. Apparently the remarkable number of new herbicides developed during the past decade (sulfuric acid, Sinox, ammonium sulfamate, sodium pentachlorophenate, oils, 2,4-D, 2,4,5-T, Sizzweeder, mechanical shredder, 2,4-dinitro-6-sec-butyl phenol, etc.) has stimulated an organized attack on weeds that will bear watching.

For convenience, herbicides can be divided into several groups: (1) soil sterilants, illustrated by sodium arsenite, ammonium thiocyanate, borax or borate ores, carbon bisulphide, chloropicrin, and sodium chloride; (2) nonselective contact sprays, such as the numerous nonselective oil, acid, and salt derivatives which kill all vegetation down to earth; (3) selective sprays, illustrated by sulfuric acid, oils, and Sinox, which wilt down most broadleaf weeds, but leave grains, flax, and grasses virtually unaffected; (4) *translocated poisons*, illustrated by arsenic trioxide, arsenic trichloride, sodium chlorate, ammonium sulfamate; (5) flame thrower, illustrated by the Sizz-weeder, a machine designed especially for weeding row crops; (6) growth regulators or hormones, such as 2,4-D and 2,4,5-T—substances which in relatively minute quantities stimulate abnormal growth followed by death of plants; and (7) miscellaneous devices, including a machine for moving and crushing the water hyacinth, soil covers or barriers to suffocate weed growth, cover crops, etc.

HISTORY

The principle of selective weed killing with chemical sprays has been known for over a half century (*21*). A concentrated iron-sulfate solution was used against weeds in cereals for many years both in Europe and America and with some success. Bolley (*3*), in North Dakota, demonstrated that iron sulfate could be used to kill some weeds in cereals. Rabate (*20*) opened a new era by employing dilute sulfuric acid, but little came from his work until later.

Of the various materials, the soil sterilants were probably the earliest herbicides used by man. Many salts of acids, when applied to the soil in sufficient quantity, will kill all plant growth. The soil is thereby rendered unfit for growing plants until the chemical has been leached out by rains. For killing deep-rooted perennials, 250 pounds of table salt, 15 to 30 pounds of borax, and 3 to 4 pounds of sodium arsenite are required to treat one square rod of area. Many nonselective contact sprays contain sodium arsenite alone or in combination with sodium chlorate. This, however, is very poisonous to livestock, is expensive, and is a fire or explosion hazard. Aside from soil sterilants and nonselective contact sprays, most herbicides used today are new.

Sulfuric Acid

Ball and French (*1*) were the first to point out the possibility of using dilute sulfuric acid for killing weeds among young onions. Newhall, *et al.* (*19*) extended this work and demonstrated that, when properly applied, sulfuric acid functioned as an inexpensive, rapid method of killing weeds. One gallon of cheap ($.35) sulfuric acid added to 50 gallons of water made enough solution to spray one-half acre of onions. Weeding time and expense were cut to one-fourth by this method. Most weeds are killed, but certain ones, like grasses of upright growth or lamb's-quarters and purslane which have waxy bloom, are not easily wet by the acid and may not be killed.

Sinox

Sinox (sodium-dinitro-ortho-cresylate), a coal tar derivative in the form of yellow dye, was first used as a selective herbicide in France in 1933 and as a weed spray in the United States in 1938. It is also an insecticide and pollenicide. This herbicide has been used in extensive field trials in many places, including California (*27*), North Dakota (*10*), Montana (*15*) and Canada (*32*). Westgate and Raynor (*27*) obtained successful results in cereals and flax with spray rigs mounted on trucks and on airplanes. For airplane application the cost was about a dollar more than for ground rigs, averaging $3.65 an acre for controlling wild mustard and $4.65 for wild radish, fire weed, and yellow star thistle. The dosage of 1 gallon of Sinox to 120 gallons of water was applied at the rate of 80 to 100 gallons per acre on mustard when the weed was 3 to 7 inches high and had 3 to 7 leaves. Established transplanted onions were also sprayed with safety until they were approximately 10 inches high. Common dandelion, common plantain, and crab grass were successfully controlled in bluegrass lawns.

Sinox kills only the broad-leaved annual weeds, including ragweed, and has little effect on grasses. The young seedling weeds are most easily killed. Spraying with Sinox, Helgeson and Gebracht (*10*) increased the yields of flax by as much as 232 per cent. In their report on three seasons work, Litzenberger, *et al.* (*15*) obtained yield increases up to 264 per cent. They cautioned that flax and peas should never be sprayed before reaching 3 inches and never after bud formation. Small grains may be sprayed when taller, but treatment should be made before they reach jointing stage.

Schwendiman, *et al.* (*22*) studied the effects of Sinox on legume seedlings, weeds, and crop yields in Wisconsin and reported that Sinox killed 0 to 70 per cent of alfalfa and red clover up to 4 weeks of age, but that these plants developed a high resistance to this herbicide when 4 to 6 weeks of age.

Sinox, together with ammonium sulfate as an activator, has been used by Bonde and Schultz (*4*) and others for killing the tops and thereby controlling the late blight tuber rot of potatoes. Sinox spray also aids in harvesting and improving the quality of potatoes for early market, and enables growers to harvest the crop before the onset of freezing weather.

Ammonium Sulfamate

Ammonium sulfamate is technically a contact and translocation herbicide. For about 60 years it was known as a laboratory curiosity in chemistry. Originally it was sometimes used for fireproofing wood. Recently Du Pont chemists found an economical way to produce this in large quantities. In 1941 (*11*) it was found to be a more suitable herbicide than sodium chlorate for eradicating chokecherry, the wild host of the yellow-red or "X" disease of peach. It is also excellent for poison ivy, but was not satisfactory for killing water hyacinth (*7*). For spraying, about three-fourths of a pound of this salt is dissolved in a gallon of water and applied at the rate of from 1 to 3 gallons per 100 square feet of weed growth area. Ammonium sulfamate is nonpoisonous to animals, free from fire hazard, and does not leave the soil sterile for more than a short time. In fact, it contains a high percentage of fixed nitrogen which enriches the soil. Aside from its use for such special weeds as chokecherry and poison ivy or small areas of noxious perennial weeds where its nonselective action is tolerated, the cost of "Ammate" is too high to allow it to be used generally on large areas.

Sodium Pentachlorophenate or "Santobrite"

Santobrite was recommended by Hirsch (*12*) at a concentration of 5 ppm for retarding growth of water hyacinth where its complete removal is not essential or in zones where other life is to be preserved, and of 80 ppm for complete elimination.

Oils

Oils have long been known to be toxic to plants. It has been only recently, however, that their value as selective weed killers has been recognized. In California and other far-western states oil sprays have been used for weeding carrots on a commercial scale since 1943 (*6*). Oils are applied full strength, undiluted, and have since been widely used in several central and eastern states, including New York (*23, 24*), Massachusetts (*13*), Michigan (*8*), Wisconsin (*26*), and others. Kerosene was reported by Loomis and Noecker (*16*) and Litzenberger and Post (*14*) as a selective spray for dandelions in lawns. According to Warren (*26*), all important annual weeds in Wisconsin carrot fields, with the exception of ragweed,, are easily killed by oil spray. In perennial weeds, such as quack grass and Canada thistle, the tops are burned severely, but the roots are not killed. One oil spray of carrots costs about one-half that of hand weeding, or about $13 an acre.

Sweet, *et al.* (*23*) report that the plants tolerant to oil sprays are members of the Umbelliferae family—carrots, celeriac, taprooted parsley, and celery. Some tolerant weeds are ragweed, wild carrot, galensoga, and a few grasses.

Young (*29*) reported that oils are translocated in onions and potatoes, are located principally between parenchyma cells, and persist in the tissues several months. He suspected toxic substances in the oil as one cause of death and mentioned physical suffocation as another.

Sweet, *et al.* (*24*) consider that the general types of injury possible from petroleum products are "chronic" and "acute." Chronic injury is associated with heavy oils, such as lubricating and motor oil. It is slow in action and kills practically all plants including carrots, due to "suffocation" of the tissues. Acute injury is due to chemical composition of the oil and is correlated with toxic aromatic content. It often acts within an hour or two after it has been applied. Carrots are rather tolerant of aromatic compounds, whereas most other vegetables and weeds are not. It is on this basis that oils can be used as selective weed killers. To avoid chronic injury only light-weight oils are used. The best are: (1) dry-cleaning fluids sold as Stoddard Solvent and (2) kerosenes that have 12 to 15 per cent aromatics. The important thing in application is thorough, uniform coverage of weeds when the carrots have 2 to 4 "true" or "fern" leaves and preferably before the weeds are over 3 inches tall. Due to oil absorption and slow dissipation, only one spray can be used for bunching carrots, as a month must elapse before harvest to get rid of the oil absorbed.

2,4-Dichlorophenoxyacetic Acid

The outstanding sensation concerning weed killers in 1944 was the public announcement of growth-regulating substances or plant hormones as herbicides. Work of a preliminary nature, started in July and published in August 1944 (*9*), demonstrated that 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) were selective herbicides. Credit for the original discovery of the chemical itself goes to Zimmerman and Hitchcock (*30*), and for methods of handling it in work on plants, to Mitchell and Hamner (*17*).

Because plant hormones operate on the principle of growth regulation rather than caustic action or poisoning, this discovery marks a new departure in the history of herbicides and promises in the future to prove particularly rewarding in special cases. The first tests (*9*) demonstrated that 1,000 ppm and 500 ppm of 2,4-D were effective in killing perennial bindweed (*Convolvulus arvensis* L.) on nursery fruit trees. Similar concentrations of 2,4,5-T also seemed to possess almost equally effective herbicidal properties against this weed. When it is remembered that black bindweed is considered the number one weed enemy of crops (herbaceous and woody) and that the quantity of material is measured in parts per million rather than in pounds or gallons, the sensation created by the discovery of 2,4-D can be readily understood.

The first results (*33*) were so remarkable that tests by a multitude of public and private agencies were conducted throughout the Nation (*34*), and in England (*2*) in 1945. This new departure is not the whole story of recent developments of scientific and practical interest on herbicides but only the beginning.

The most interesting characteristic of plant hormones is the small dosages needed to be effective. At 10 ppm, more or less, hormones in general produce beneficial effects. When increased to between 100 and 1,000 ppm, the 2,4-D hormone stimulates abnormal growth. The usual application is one-fourth to one-half ounce per square rod. Therefore, one pound incorporated into a spray would cover from 32 to 64 square rods compared with one-third to one-fourth square rods for such chemicals as sodium arsenite, sodium chlorate, and ammonium sulfamate. Although usually applied in water sprays, hormones may also be incorporated into dusts and aerosols.

Under favorable conditions 2,4-D applied to foliage migrates and causes death of entire deep root systems. Other important characteristics of 2,4-D are that it is noncorrosive, nonirritating to skin, and nonexplosive. Feeding trials with animals have been conducted without adverse effect. Some investigators have consumed the chemical and suffered no ill effects. The action of 2,4-D is highly selective. It attacks most broadleaf plants, but there are exceptions. Tomatoes are killed by 100 ppm, whereas Kentucky bluegrass has withstood 10,000 ppm. While disadvantageous in some respects, this property may be a great advantage in others. The fact that it is used in such dilute concentrations makes it relatively inexpensive, and it should not cost over $5 to spray one acre.

The work on 2,4-D is so new that only a few general principles will be stated at this time: (1) It is most effective on young plants in periods of rapid growth; (2) it acts slowly, requiring a month to produce killing action; (3) it appears to be most effective when applied to plants growing in moist soil; (4) eradicative action seems to proceed more rapidly in sun than in shade; (5) it should not be applied within 4 hours of a rain. For details see Willard (*34*).

People with weed control problems in 1946 in farm crops, nurseries, gardens, lawns, or waterways will be greeted with an array of over 30 preparations of 2,4-D (in acid, salt, or ester form) on the market. These materials are put up as powders, liquids, pastes, and tablets. One chemical concern prepared a dust form in 1945. Aerosol carriers are also a possibility in 1946. The preparations may contain all the way from about 10 to 100 per cent of active ingredient. It is still too early to make general recommendations on the use of 2,4-D. However, in the special case of the water hyacinth there is very little choice about using a hormone herbicide, since poisonous chemicals are ruled out.

Sizz-weeder

The Sizz-weeder, or Flame Cultivator, was first tried out on cotton in Mississippi (*31*) and on some other crops in New Jersey in 1944. In 1945 it was tested for killing weeds in corn and other row crops in New York (*28*). This machine is designed to produce a hot-air-blast flame to cause dehydration and destruction of weeds and grasses while leaving the desired crop unharmed. The burners are adjustable in three planes, and the principle of flame weeding is the application of heat at any time when the crop plant to be cultivated has more fiber content (heat resistance) than the weed growths possess. This method, like that of applying herbicides in sprays, has advantages, since it eliminates cultivation which continually brings weed seeds to the soil surface for germination.

Experiments to date indicate that (1) weeds 3 or 4 inches in height can be successfully killed in row corn 6 inches high or higher without seriously damaging the corn; (2) many large weeds, although not killed, are arrested in growth; (3) results on soybeans, peas, beans, cabbage, and spinach were discouraging; (4) two burnings spaced at least a few hours apart are even more effective than four burnings in immediate succession. Some difficulties were experienced, but these should be corrected with time.

Mechanical Weeder

Gowandloch (*7*) reported on the use of a mechanical weeder for combating the water hyacinth in Louisiana. An earlier device consisted of a conveyor to deposit the water hyacinth on stream banks to perish. This craft is equipped with crushing machinery so that the hyacinth plants are incapable of reproduction when returned to the water.

Crafts (*5*) has recently announced another new herbicide, 2,4-dinitro-6-sec-butyl phenol, which possesses some advantages over chemicals like sodium arsenite and sodium chlorate.

THE FUTURE

It is not necessary to point out the possibilities of scientific development of herbicides in the future. Of all the work to be done along the weed-control front, there is no doubt that in the future hormones like 2,4-D will receive adequate attention, although much will continue to be done all along the line of attack on weeds employing chemicals and machines as herbicides.

(*See page 492 for references.*)

Plant Growth Regulators

Special Projects Division, Chemical Warfare Service
Camp Detrick, Maryland

THE USE OF PLANT GROWTH REGULATORS as herbicides is a subject of great interest to most individuals who deal with plant life. Recently this interest has increased rapidly, if one is to judge by the large number of articles on 2,4-D (2,4-dichlorophenoxyacetic acid) appearing in scientific journals as well as in lay publications.

During the war extensive tests on the use of plant growth regulators were conducted by the Special Projects Division, Chemical Warfare Service, at Camp Detrick, Maryland. Certain phases of this work were performed under contract by members of the Bureau of Plant Industry, U. S. Department of Agriculture, and the Department of Chemistry, Ohio State University. Results of these investigations will be published in part in the June issue of *Botanical Gazette*. Other papers on the subject will appear from time to time in other journals. A brief summary of the results of this work is given here.

Over a thousand compounds were prepared and tested. Since it was impractical to test all potential plant growth regulators on a great number of plants, several screening procedures were devised which permitted the rapid and accurate evaluation of the physiological activity of each compound. The most important screening tests were (a) measurement of inhibition of root elongation of germinating corn seed, (b) measurement of inhibition of tissue production of red kidney beans when a single droplet of the substance, dissolved in water or oil, was placed on the midrib of the primary leaf. The inhibition caused by the chemical was compared with that produced by 2,4-D. Compounds which displayed a high degree of activity in the screening tests were then tested on a number of monocotyledonous and dicotyledonous plants in the greenhouse and in the field. The compounds prepared and tested were functional derivatives of phenoxyacetic, benzoic, naphthoic, phthalic, sulfamic, carbamic, cinchoninic, and picolinic acids and a host of other organic chemicals.

In a study of methods of application it was discovered that the application of like amounts of growth regulator to the soil as a solid and to the aerial portions of plants in the form of aqueous or nonaqueous sprays produced widely differing effects, the herbicide being many times more effective when applied in a spray.

Comparatively low concentrations of growth regulators applied to the soil prevented seed germination, but when the solid chemical was applied to the soil as a contaminant, the dosage required to kill growing plants increased with increasing age of the plants at the time of application. The same age relationship was evident when the regulator was applied to the aerial portions of the plants in the form of a spray.

The persistence of these growth regulators in the soil was also studied. It was found that 2,4-D did not persist in soil for more than 80 days and isopropyl N-phenylcarbamate seemed to disappear within 60 days.

In soil-leaching experiments 2,4-D was recovered in the leachate.

Frequently compounds were encountered which were very difficult to dissolve in the solvent selected, and recourse was made to the use of cosolvents. Tributyl phosphate proved to be the most satisfactory cosolvent and was found to be suitable for preparing high concentrations of herbicides in oil solution. The carbowaxes (polyethylene glycols) were found to be suitable cosolvents for the preparation of aqueous solutions, in which they also acted as wetting agents or spreaders.

Since it had been shown that several hours are required for plants to absorb maximum amounts of 2,4-D sprayed on their leaves, an investigation was undertaken to determine to what extent heavy rainfall would remove this compound and reduce its effectiveness as a herbicide. Results show that when the herbicide was applied in oil solution, an immediate heavy rain caused no diminution in response to the herbicide, as the drops of rain appeared to be shed from the oil-covered leaves without the removal of the oil solution. When aqueous solutions of the herbicide were used, a heavy rainfall within 24 hours reduced the effectiveness of the herbicide to a marked degree. Thus, the value of oil as a solvent in herbicide applications just prior to rain or in regions of high rainfall is indicated. Another advantage of oil solutions as herbicides is the contact injury produced by tributyl phosphate, which is generally used as a cosolvent.

Studies on the mode of entry and translocation of regulators indicate that the stomata may be unimportant as a portal of entry. Young *Nasturtium* and *Coleus* plants were selected for experimentation, since they have stomata only on the lower surfaces of the leaves. Some plants were sprayed in such a manner that only the upper leaf surfaces were exposed, and other plants so that only the lower surfaces were exposed. The resulting degree of inhibition was about the same, regardless of the particular leaf surface sprayed. However, when plants are exposed to volatile growth regulators or aerosols, stomata probably play a more important role.

Often 2,4-D enters the leaf with great rapidity. On warm, sunny days young broadleaf plants sprayed with this compound may exhibit epinasty and stem curvature within one hour after treatment.

It was originally believed that there might be a high degree of compound-crop specificity. This was found to be true to a limited extent. In general, the compounds were more toxic to broadleaf plants than to grasses. One group of compounds, however—the carbamic acid derivatives and, in particular, isopropylphenylcarbamate—was more toxic to cereals than to broadleaf plants. This confirms the results of British investigators (*1*). Among the broadleaf plants only one instance of compound-crop specificity was noted. The compound, 2,4,5-trichlorophenoxyacetic acid, and its derivatives were highly inhibitory to Irish potatoes, while all the other phenoxyacetic acids and derivatives tested on this crop had little effect.

Reference

1. TEMPLEMAN, W. G., and SEXTON, W. A. *Nature, Lond.*, 1945, **156**, 630.

Obituary

John Campbell Merriam

1869-1945

Dr. John Campbell Merriam, distinguished paleontologist, died in Oakland, California, on 30 October 1945. He had just passed his seventy-sixth birthday. Since his retirement from the presidency of the Carnegie Institution of Washington, which office he held for 18 years, Dr. Merriam had continued his writing and scientific study on the Pacific Coast, spending much of his time at the California Institute of Technology. In 1943 he became consultant and lecturer at the University of Oregon, where he was associated with the Departments of Geology and Anthropology. These were his last scientific interests before his health failed.

Born in Hopkinson, Iowa, Merriam received his early education at home and in the schools of that state. It was here that he saw his first fossils—the Paleozoic invertebrates he collected not far from his father's home. After taking a bachelor's degree at Lenox College, Iowa, he came to the University of California to study geology under Joseph Le Conte and botany under E. L. Greene. During this period he was an assistant in mineralogy. As was customary in those days, Merriam went to Munich for advanced study, receiving his doctorate at the University under Karl von Zittel. His dissertation related to mosasaurs from the Kansas chalk. On his return to the University of California in 1894 he taught and conducted research in invertebrate paleontology.

However, vertebrate paleontology claimed his major interest, and there followed published accounts by him and by his students on cave explorations and early man in California, Triassic ichthyosaurs and thalattosaurs, and on the geology of the John Day basin. He later enlisted the aid of Miss Annie M. Alexander in his research, and the generous response of this fine and steadfast patroness of paleontology and zoology was an important factor in permitting him to achieve success. Even before completion of the work on fossil reptiles his interest turned more strongly toward fossil mammals and early human history. Among his many papers, those which relate to western Tertiary faunas, correlation studies, and to the deposits and faunas of Rancho La Brea may be cited as among his most significant contributions. They were published for the most part in his productive period of research at the University from about 1900 to 1919. These were the years when a number of students came under his influence, and many men receiving instruction from him were subsequently to find responsible posts in science and industry.

During this time he became increasingly active in the affairs of the University and of the community. He was particularly interested in promoting research and in furthering the publication of original investigations. In 1912 President Benjamin Ide Wheeler appointed him chairman of a newly formed Department of Paleontology. At the time of World War I he saw the urgency of a national defense program. He became chairman of the Research Committee, California State Council of Defense, which office he held from 1917 to 1920. In 1919 he was chairman of the National Research Council. Later, in 1920, he became dean of the faculties at the University.

Although considered a candidate for the presidency of the University of California during the period which followed the retirement of Dr. Wheeler, Merriam accepted the presidency of the Carnegie Institution of Washington. It was his belief that, rather than continue his career as paleontologist, he should serve science broadly and more effectively by becoming head of a great research foundation.

During the next 18 years he was occupied with the innumerable tasks which face an executive of a large organization. This period of service is perhaps most noteworthy because of a certain centralization of the activities of the Carnegie Institution of Washington, although he enlarged the group of research associates who were affiliated with other institutions of learning. He gave stimulus to publication of scientific results and to a dissemination of knowledge gained by eminent scholars of the Institution staff through popular articles, lectures, and demonstrations. He was responsible for the establishment of a Seismological Laboratory and a program of seismological research on the Pacific Coast as a cooperative plan of the Institution and the California Institute of Technology. He was also much interested in the program of archaeological research in southern Mexico and Guatemala. Later, the investigation included studies of early man in America and Asia. Paleontology and paleobotany likewise received added support.

All his activities were by no means confined to the Carnegie Institution of Washington. Dr. Merriam continued for a time as regent of the Smithsonian Institution. He fostered the unique educational features of some of our National Parks. He was president of the executive committee of the Pan-American Institute of Geography and History from 1935 to 1938. He carried over from his university days his association with the Save-the-Redwoods League and for 24 years continued as its president until his retirement from that office in 1944. These were the years when he brought to publication most of the articles and essays of a more general and philosophical nature. His broad interest in the human values derived from education and research led to the publication of his book, *The living past*. On his retirement in 1938, the Carnegie Institution reprinted all his papers and addresses and published likewise an appreciation volume entitled: *Cooperation in research by staff members and research associates.*

Articles of general scope and his second book, *The garment of God*, were published after his retirement. He continued to concern himself with the National Parks of the West and with the State Parks of Oregon. Largely through his activity, the group known as the John Day Associates was established with the purpose of conserving the famous fossil beds of the John Day basin and of developing public interest in the geological story so clearly told by the rocks and fossils of the region.

Some paleontologists never weary, even in old age, in their devotion to the study of fossils. In the later period of his life, however, Merriam never again applied himself to this kind of research, being content to let others carry on. His eminence in science was recognized, and acknowledged in the usual way. Honorary degrees were awarded him by many universities. He was a member of the Society of Vertebrate Paleontology, president of the Paleontological Society in 1910, president of the Geological Society of America in 1919, president of the American Society of Naturalists in 1936, and a member of the National Academy of Sciences, Academia Nacional de Ciencias Antonio Alzate de Mexico, and Sociedad de Geografía e Historia de Guatemala. A gold medal was awarded him by the American Institute, New York.

Thus, Merriam's interests were not only in paleontology. During his lifetime he was also educator, conservationist, administrator, and philosopher. By nature not genial, but rather grave and distant, he nevertheless left the impress of his thought on students and on men and women in many walks of life. By them he will be long remembered.

CHESTER STOCK

California Institute of Technology

Technical Papers

Use of 2,4-Dichlorophenoxyacetic Acid as a Selective Herbicide in the Tropics

J. van Overbeek and Ismael Vélez

Institute of Tropical Agriculture, Mayagüez, Puerto Rico

During the past year extensive trials were conducted on the use of 2,4-dichlorophenoxyacetic acid[1] as a selective herbicide for tropical crops in Puerto Rico. Its most beneficial use is in the sugar-cane culture, but in coffee plantations also it promises to be of considerable importance. While many of the major weeds associated with these crops are highly susceptible to 2,4-D, neither sugar cane nor the coffee plant have shown any adverse effects of sprays up to 0.3 per cent concentration.

It was found that weeds could be divided into four classes in regard to their sensitivity[2] to 2,4-D:

Class I consists of a group of highly sensitive plants, represented by Curve I of Fig. 1. *Commelina,* one of the most serious sugar-cane weeds in moist lands, is the main representative of this group. A single treatment with 0.05 per cent of 2,4-D at a cost which is often as low as 50 cents per acre[3] gave sufficient control. Several species of *Ipomea,* and *Stizolobium pruritum* (Wight) Piper (the *pica pica* feared by sugar cane workers on account of its stinging hairs), fall in the same sensitivity class, as does *Urera baccifera* (L.) Gaud., the giant nettle, which is a major pest in coffee plantations. Other weeds belonging to this class are: ***Bidens cynapiifolia,*** H. B. K., ***Cissus sicyoides*** L., ***Cleome gynandra*** L., ***Clerodendrum fragans*** Vent., ***Momordica charantia*** L.

Class II is a group of weeds characterized by Curve II and represented by several species of *Amaranthus* (pigweed). To this group also belong: *Achyranthes sessilis* (L.) Steud., *Kallstroemia caribaea* Rydgerg., *Poinsettia heterophylla* (L.) Kl. Garcke., *Ricinus communis* L., *Solanum torvum* L., *Synedrella nodiflora* (L.) Gaertn., *Teramnus uncinatus* (L.) Sw., and *Wedelia trilobata* (L.) Hitch.

Class III is a group of weeds characterized by Curve III, the major representative being *Cyperus rotundus* L. (nutgrass). Sufficient control was usually obtained with 0.15 per cent sprays. Other plants belonging to the same group are: *Chamaescyce* spp., *Crotolaria retusa* L., *Malachra capitata* L., *Portulaca oleracea* L., *Sida* spp., *Trianthema portulacastrum* L., and *Vernonia cinerea* (L.) Less.

Class IV comprises a group of plants which are relatively insensitive to 2,4-D sprays. Grasses are the most typical representatives of this group. However, the following nongramineous plants were also found to be resistant: *Aeschynomene* spp., *Aloe vulgaris* L., *Bradburya pubescens* (Benth) Kunth., *Bryophyllum pinnatum* (Lam.) Kurtz., *Chamaecrista* spp., *Dieffenbachia seguine* (Jacq.) Schott., *Emelista tora* (L.) Britton and Rose, *Indigofera suffructicosa* Mill., *Jussiaea angustifolia* Lam., *Meibomia supina* (Sw.) Britton, *Mimosa pudica* L., *Opuntia dillenii* (Kerr-Gawl) Haw., *Persicaria punctata* (Ell) Small, *Petiveria alliacea* L., *Urena lobata* L., *Xanthoxalis corniculata* (L.) Small.

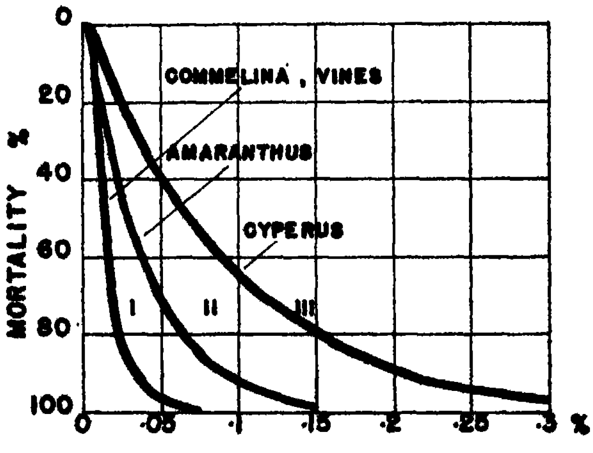


Fig. 1

The action of 2,4-D differs considerably from that of weed killers of the conventional type. The latter act rapidly, have a burning action on the foliage, but often do not damage the growing point sufficiently to prevent regeneration. On the other hand, 2,4-D penetrates inside the plant and without the typical leaf-burning destroys the growing regions in the course of a few weeks. In *Commelina* the growing point and the intercalary growth regions are destroyed. In *Cyperus* the well-protected growth region, located within the base of the leaf sheaths and 5 cm. or more below the surface of the soil, is decayed, while at the same time the leaves show no more serious outward sign of damage than yellowing.

---

[1] Converted into the more water-soluble ammonium salt by the addition of NH_4OH on an equimolecular basis.

[2] Applications were made to young weed plants, since it was found that mature plants are generally relatively insensitive.

[3] Cost of chemical only, applied at a rate of 80 gallons per acre. Depending upon the type of weed infestations, applications varied between 50 and 250 gallons per acre.

This preferential action on the growing region suggests that 2,4-D owes its effectiveness to competitive action with the plant's native growth-regulating substances. The fact that 2,4-D itself has definite growth-regulating properties (*1*) further strengthens this assumption.

Although in practice 2,4-D is sprayed on the surface of weeds rather than on the soil, some of it is bound to come in contact with the soil. In order to determine spray residues in soils, a test was devised which was based upon the high sensitivity of radish seedlings to 2,4-D. When radish seed was germinated on cotton soaked in 2,4-D solutions, it was found that concentrations as low as 0.1 ppm cause a striking reduction in root and hypocotyl growth in comparison to seeds germinating in water. A similar effect was found in radish seedlings germinating in soils which had been sprayed with 2,4-D. Under the conditions of our experiments 2,4-D was detectable in soils up to three weeks after 0.15 per cent solutions were sprayed directly on the soil at a rate of 300 gallons per acre, and up to five weeks when 0.3 per cent solutions were applied.

Reference

1. ZIMMERMAN, P. W. *Cold Spr. Harb. Sympos.*, 1942, **10**, 152–157; ZIMMERMAN, P. W., and HITCHCOCK, A. E. *Proc. Soc. hort. Sci.*, 1944, **45**, 353–361; VAN OVERBEEK, J. *Science*, 1945, **102**, 621.

Control of Ragweed Pollen Production With 2,4-Dichlorophenoxyacetic Acid[1]

FREDERICK G. SMITH, CHARLES L. HAMNER, and
ROBERT F. CARLSON

New York State Agricultural Experiment Station
Cornell University, Geneva, New York

In surveying the selective herbicidal action of 2,4-dichlorophenoxyacetic acid, Hamner and Tukey (*2*) found that ragweed was among the more sensitive of the common weeds. Since ragweed is probably the most important cause of pollen allergy, its control is of great importance both as an economic and a public health measure. It was desirable, therefore, to investigate further the application of 2,4-D to ragweed control and to point out the practical possibilities.

In many urban areas in the East and Middle West before the war considerable effort and expense was put into campaigns to eradicate ragweed by cutting or treatment with various herbicides. The success of this means of controlling allergy due to ragweed pollen, and public interest in it, could undoubtedly be greatly increased by the availability of a cheaper, more effective method. Grigsby (*1*) has recently reported the use of several of the newer herbicidal compounds in ragweed control and has suggested that 2,4-D may be more effective. The essential requirement of any method, as Grigsby points out, is to prevent the formation or shed of pollen; but it is also desirable (1) to cause as little damage to other vegetation as possible, (2) to leave no residue toxic to animals, and (3) to require the minimum in cost of materials, time, and equipment.

RESULTS

Beginning on 26 July, plots 5 yards square were treated at weekly intervals in three locations where both eastern species of ragweed, *Ambrosia artemisiifolia* L. and *A. trifida* L., were growing abundantly among other common weeds. The treatments were made by water sprays of 1,000 ppm of 2,4-D containing 0.5 per cent Carbowax 1,500, as described by Mitchell and Hamner (*4*), and were applied with a 5-gallon knapsack sprayer at the rate of about 100 to 200 gallons per acre. Notes on the stage of flower development at the time of treatment and frequent observations of the effects were made to determine the latest safe time for treatment to prevent pollen formation or shed.

At the time of the first series of treatments the majority of plants had racemes varying from a few millimeters to 20–30 mm. in length. Within 24 hours these plants showed pronounced epinasty and twisting of pedicels, leaves, and stem tips. By the fourth day the twisting was more severe, growing points were enlarged, longer racemes were pendant, and a few lower leaves were chlorotic. By the fourteenth day none of the involucres had opened, and no further development of the flowers had taken place. Many plants showed extensive swelling and splitting of stem tips and the death of lower leaves. By the twenty-eighth day (23 August) the tops of about half of the smaller plants were dead, and larger plants showed typical red and yellow fall colors and were dying back from the tips. Controls at this time had developed normally and were shedding pollen.

At the time of treating the second series of plots (2 August) some of the racemes were fully developed and involucres were starting to open. Symptoms developed similar to the first treatment, and by the twenty-first day (24 August) some plants were dead, and there was no sign of pollen shed. Most of the involucres had not opened, and in those which had, the pollen sacs were dead.

At the time of the third series (10 August) most of the involucres were open, and some of the pollen sacs were mature. Eighteen days later (28 August) the younger racemes and tips of the older ones were dead, and no pollen had been shed, but at the base of the

---

[1] Journal Paper No. 646 of the New York State Agricultural Experiment Station, Cornell University, 20 September 1945.

older racemes there were empty pollen sacs and pollen could be squeezed from others. The fourth series (17 August), at the time pollen shed was starting, showed the same general symptoms by 28 August as the third treatment except that the proportion of surviving pollen sacs and the extent of shedding was greater. Though the third and fourth treatments clearly caused reduction in the amount of pollen shed, they were too late to prevent it completely. That the pollen shed from these late treatments was not altogether normal was indicated by their vacuolate condition, similar to the effect of 2,4-D on bindweed pollen (*6*). No test was made, however, of their allergenic properties.

These experiments indicated that the safest procedure would be to treat plants before the involucres are open. Limited trials with lower concentrations and more extensive experience with other weeds have indicated that concentrations lower than 1,000 ppm might be equally effective in stopping development of the flowering parts, though the response would probably be slower.

A preliminary trial was also made of a new method of treatment which shows great practical possibilities in the large-scale application of chemical agents to plants. On 6 August a test of 2,4-D with a fog machine[3] was made, in which a 1-per cent solution in SAE 80 oil was "fogged" across an area of mixed weeds at the rate of about 1 to 2 gallons per acre from the back of a truck moving 3 or 4 miles per hour. Despite unfavorable atmospheric conditions, cool and damp with updrafts, telemorphic effects were visible on ragweed up to 100 feet from the machine within 24 hours. A week later severe symptoms were found throughout the first 50 feet, and many plants were already dead in the first 10 feet. The response was at least as rapid and apparently as effective in preventing pollen shed as the water spray. Because of the possible advantage of more highly oil-soluble compounds in fog application, the ethyl ester of 2,4-D was prepared and tested on a small scale. Dimethyl ether aerosols gave responses on ragweed similar to 2,4-D.

CONCLUSION

Water sprays of 2,4-D at 1,000 ppm at sufficiently early stages of flower development were shown to be effective in preventing pollen shed, though further work may show that lower concentrations or rates of application would be sufficient. A preliminary trial with a fog machine showed excellent possibilities, and with further experiments to determine the best carrier, concentration, and technic of fog application it promises to be a more economical method than sprays. Apart from any differences in amounts of 2,4-D required in the two methods, the fog machine would have the advantages (1) of avoiding the large volumes of water necessary in spray methods, (2) of swifter application, and (3) of requiring considerably lower cost in equipment. This new technic of application, combined with relatively low cost, favorable selectivity of herbicidal action (*3*) and low toxicity (*5*), make 2,4-D a promising herbicide for ragweed control. It is hoped that these experiments will encourage others to test 2,4-D on a larger scale.

---

[3] Made available through the courtesy of the Todd Shipyards Corporation.

References

1. Grigsby, B. H. *Science*, 1945, **102**, 99–100.
2. Hamner, C. L., and Tukey, H. B. *Bot. Gaz.*, 1944, **106**, 232–245.
3. Hamner, C. L., and Tukey, H. B. *Bot. Gaz.*, 1944, **106**, 232–245; Mitchell, J. W., and Marth, P. C. *Bot. Gaz.*, 1944, **106**, 224–232.
4. Mitchell, J. W., and Hamner, C. L. *Bot. Gaz.*, 1944, **105**, 474–483.
5. Mitchell, J. W., and Marth, P. C. *Bot. Gaz.*, 1944, **106**, 199–207.
6. Tukey, H. B., Hamner, C. L., and Imhof, B. *Bot. Gaz.*, 1945, **107**, 62–73.

Rapid Estimation of the Phytocidal Action of Chemicals[1]

H. R. Offord
Bureau of Entomology and Plant Quarantine
Agricultural Research Administration, USDA
Berkeley, California

Recent reports on the herbicidal action of substituted phenoxy compounds (*1, 3, 5*)[2] have stimulated investigations of organic compounds which are essentially new to workers doing research on weed-control problems. The large number of organic compounds which might legitimately be selected for test as herbicides, together with the high cost and limited supplies of many of these chemicals, require that preliminary tests of their toxicity be simple, rapid, and economical. The utilization of *Lemna minor* L. (smaller duckweed) as a test plant fulfills most of these requirements.

The procedures here proposed should provide direct evidence of the effectiveness of chemicals for the destruction of aquatic plants—a matter of widespread interest and of economic importance. Tests with duckweed, however, will not necessarily indicate the magnitude of the toxic action of an unproved herbicide on a terrestrial plant. For investigators concerned with terrestrial plants, the proposed tests should provide useful data on the comparative phytocidal action of a group of new chemicals and, in particular, should indicate the relative toxicity of low concentrations of new and proved herbicides. In insecticidal as well as herbicidal investigations, there is considerable interest in recognition of the phytocidal action of low concentrations of chemicals. Data from tests with duckweed should facilitate evaluation of potential foliage damage by new chemicals, once preliminary standards have been established by which correlations can be made between reactions of duckweed and the particular foliage or plant under consideration. Tests with duckweed, or any other test plant in the laboratory or greenhouse, should be considered as preliminary to final evaluation of the herbicide under field conditions, and for the particular weed under investigation.

---

[1] Work conducted for the purpose of improving methods for the chemical eradication of *Ribes* to control white-pine blister rust, *Cronartium ribicola* Fisher. Greenhouse and laboratory facilities used by the Bureau of Entomology and Plant Quarantine at the University of California, Berkeley, are maintained in cooperation with the College of Agriculture through its Department of Forestry.

[2] The following features of 2,4-dichlorophenoxyacetic acid, a substituted phenoxy compound, differentiate it from compounds previously recognized as effective herbicides: (1) very low solubility in water, (2) telemorphic action, (3) effective killing action of small dosages, and (4) selectivity of toxic action. Data on the action of 2,4-dichlorophenoxyacetic acid as a differential herbicide are given by P. C. Marth and J. W. Mitchell (*Bot. Gaz.*, 1944, **106**, 224–232).

Aquatic plants such as *Nitella, Valonia, Chlorella,* and *Lemna* have been used extensively as test plants for many types of physiologic studies. *Nitella clavata* (Bertero) A. Br. has been used specifically to study the toxic action of the herbicide, sodium chlorate (*6*), and *Lemna minor* for investigations of the herbicidal properties of the oxyhalogens (*4*). More recently, growth stimulation by low concentrations of ammonium sulfamate (*2*) has been shown by the rate of increase in numbers of *Lemna minor.*

Lemna minor, a monocotyledon, is a chlorophyllose, floating aquatic plant which reproduces aggressively by vegetative means. The upper surface of its leaf-like stems, or fronds, is uniformly bright green. Large numbers of test plants can be maintained in small space in simple, inexpensive containers. Plants do well in dilute nutrient solution at a pH of about 5–6 or in tap water over a small amount of sandy soil, and can be grown readily at all times of the year. For ease of handling and convenience of observation, *Lemna minor* has recently been used in this laboratory in preference to other plants for rapid estimation of the toxic action of expensive chemicals. *Spirodela polyrhiza* was used for the same purpose, but the normal variegated color of its fronds interfered with observation of early symptoms of injury.

In preliminary tests of new herbicides made by the writer during an 18-month period, the rate and character of damage to *Lemna minor* were used as measures of toxicity. Four different, clearly detectable, and replicable reactions of *Lemna minor* were observed in the course of toxicity tests with herbicides in concentrations not immediately destructive to the tender plants. These reactions may be described as follows:

(a) Damage progresses steadily, as shown by chlorosis and discoloration of fronds. The end result is a generally uniform discoloration of the fronds. Plants are not split into components or frond combinations smaller than those originally present. The typical color of injured fronds is reddish brown to pale yellow or albino. There is no change in the total area of the fronds.

(b) Plants divide to form single or double fronds before discoloration becomes noticeable. Subsequent chlorosis takes place slowly, but uniformly, on all fronds. The end result is a generally uniform discoloration of fronds. Most or all of the plants are split into single fronds. The typical color of injured plants is a pale or yellowish green. There is no change in the total area of the fronds.

(c) Damage is slow and varies among the test plants. Single fronds break from the parent plant, and these separated fronds may be damaged while the fronds of the parent plant remain fairly green and normal in appearance. The end result is an uneven discoloration of fronds. There is no apparent change in total area of the fronds.

(d) Plants divide into single or double fronds without evidence of injury. Some stimulation of growth and regeneration is evident from the increase in the number and the total (estimated) area of the fronds. Fronds remain dark green in color and healthy until bacterial action, lack of nutrient, or protracted contact with the chemical solution causes injury.

In comparing the toxicity of an organic compound, such as 2,4-dichlorophenoxyacetic acid, with a series of its homologues or analogues, the following procedure is recommended: Prepare standard test solutions of the 2,4-D which provide a range of concentration from that which is rapidly toxic (1,000 ppm damages within a few hours) to that which is relatively nontoxic (10 ppm exerts no significant damage for several days). Prepare solutions of the new herbicides in concentration equivalent to the standard. Measure 50 ml. of the several test solutions into Petri dishes. Three replications are adequate for most purposes. Place the same number (10 or more) of duckweed plants in each test solution (including a control of tap water or a dilute nutrient solution of conventional composition), taking care to select vigorous, healthy plants of a uniformly green color. The number of fronds per plant need not be the same for all tests. For each culture, record the number of plants, the total number of fronds, and the time of immersion, so that comparisons between number of plants and fronds in the control and the several test solutions can be made at regular intervals. Unless the pH effect is the immediate object of the tests, the pH of the test solutions should be approximately the same, because excess acid or alkali exerts a definite toxic action on duckweed. The temperature of the solutions and the light intensity should also be generally comparable for all tests. Under these conditions the rate at which damage occurs and the character of the damage, as previously described, will provide an estimate of toxicity of equivalent weights of the standard and the new herbicides.

Attention is called to the convenience and economy in the use of *Lemna minor* for estimating the phytocidal action of chemicals where a large number of tests are needed and where cost and availability of chemicals are important considerations. This plant may be useful as physiological test material in assaying the potency of commercial preparations of weed killers, particularly those containing organic poisons not easily determined by conventional methods of chemical analysis. Results of toxicity tests on duckweed should be directly applicable to practical problems in the control of aquatic plants.

References

1. Beal, J. M. *Bot. Gaz.*, 1944, **105**, 471.
2. Fromm, F. *Science*, 1943, **98**, 301.
3. Hamner, C. L., and Tukey, H. B. *Science*, 1944, **100**, 154.
4. Hessenland, M., Fromm, F., and Saalmann, L. *Angew. Chem.*, 1933, **46**, 577.
5. Mitchell, J. W., and Hamner, C. L. *Bot. Gaz.*, 1944, **105**, 474.
6. Offord, H. R., and d'Urbal, R. P. *J. agric. Res.*, 1931, **43**, 791.

Tributyl Phosphate as a Solvent for Preparing Concentrated and Oil-miscible Solutions of 2,4-Dichlorophenoxyacetic Acid and Similar Substances[1]

W. B. Ennis, Jr., Lt., H. E. Thompson, Lt. (j.g.), and H. H. Smith, Lt., USNR

Camp Detrick, Frederick, Maryland

Concentrated solutions of many difficultly-soluble growth-regulating compounds for use in oil solutions may be prepared by the use of tributyl phosphate.

During the past few years much attention has been given to the use of 2,4-dichlorophenoxyacetic acid as a plant growth regulator and weed killer. For practical use in sprays, this compound, and others of a similar nature, must be used with a diluent or carrier. This acid is only slightly soluble in water, and attempts to dissolve it directly in inexpensive mineral oils, such as kerosene and fuel oil, have been unsuccessful. In an effort to find a suitable co-solvent of 2,4-dichlorophenoxyacetic acid for use in mineral oils, over 50 of the more common organic solvents were tested, and of these only tributyl phosphate proved satisfactory. The others were found to be unsuitable either by reason of insufficient solvent power, immiscibility with oil, or undesirable volatility. The co-solvent ability of tributyl phosphate in this combination is a critical property of this compound, since closely related substances such as triethyl phosphate and tricresyl phosphate are unsatisfactory.

At ordinary temperatures tributyl phosphate will dissolve up to about 36 per cent, by weight, of 2,4-dichlorophenoxyacetic acid. A range of from 5 to 36 per cent of the compound dissolved in tributyl phosphate was found convenient and useful for subsequent dilution with mineral oils. Best results have been obtained with solutions in which the ultimate concentration of 2,4-dichlorophenoxyacetic acid was from 0.5 to 5.0 per cent by weight after dilution of the tributyl phosphate solution with kerosene or low-grade fuel oil.

The solutions of 2,4-dichlorophenoxyacetic acid and tributyl phosphate are stable at ordinary temperatures, have no heat of solution when dissolved in mineral oils, and are miscible with them in all proportions. In addition, tributyl phosphate causes local burning of plant tissues at points of direct contact, which, for herbicidal purposes, may be desirable. There is evidence that greater inhibition, per unit weight of compound, is produced in some broad-leaved plants when 2,4-dichlorophenoxyacetic acid is applied in oil solutions containing tributyl phosphate than when the acid is applied in the form of aqueous solutions. It is not known whether the increased inhibitory effectiveness of such solutions is due to the contact injury produced by tributyl phosphate.

Tributyl phosphate also has been found to be capable of dissolving large amounts of 2,4,5-trichlorophenoxyacetic acid, para-chlorophenoxyacetic acid, 2-methyl-4-chlorophenoxyacetic acid and other substituted phenoxyacetic acids. In general, 2,4-dichlorophenoxyacetic acid can be replaced with equivalent amounts of one of the three compounds named above. This solvent likewise is useful in preparing concentrated solutions of mixtures of such compounds for use as such or in oil solutions.

---

[1] Studies conducted at Camp Detrick from January to September 1945, under the direction of Dr. A. G. Norman.

Treatment of Muck and Manure with 2,4-Dichlorophenoxyacetic Acid to Inhibit Germination of Weed Seeds[1]

C. L. Hamner, J. E. Moulton, and H. B. Tukey

Department of Horticulture, Michigan State College, East Lansing

Herbicidal sprays containing 2,4-dichlorophenoxyacetic acid have been used to destroy noxious plants (*2, 3*). Aqueous sprays at 1,000 ppm are selective in

---

[1] Journal Article 787 (N.S.) from the Michigan Agricultural Experiment Station, accepted for publication December 1945.

action, apparently not seriously affecting most grasses. Seeds of many plants, including grasses, can be destroyed by treatment with 2,4-dichlorophenoxyacetic acid. Concentrations as low as 1 ppm have a marked effect on germination and growth (*1*), and concentrations at 10 ppm will inhibit the germination of seeds of many plants. Although grass seeds are killed readily by 2,4-dichlorophenoxyacetic acid, high concentrations are required.

Muck soils and composted manure are frequently heavily infested with weed seeds. This suggests treatment of muck and manure to reduce the weed population. The importance of weed control is accentuated by the garden and truck crops commonly grown in muck and which require much hand weeding.

Muck soil in the vicinity of East Lansing, Michigan, was collected for treatment. The muck was placed in metal flats, and treatments were prepared at 1, 10, and 100 parts of 2,4-dichlorophenoxyacetic acid to 1,000 parts of muck. The 2,4-dichlorophenoxyacetic acid was applied to the muck in solution, a water-soluble preparation being used which contained 70 per cent of 2,4-dichlorophenoxyacetic acid obtained from the Dow Chemical Company. The concentrations were such as to give .01, .1, and 1 gram of 2,4-dichlorophenoxyacetic acid per square foot. After treatment, the muck flats were kept in a warm greenhouse at 60° to 80° F.

Two weeks after treatment, such weeds as lamb's-quarters (*Chenopodium album* L.), sow thistle (*Sonchus arvensis* L.), purslane (*Portulaca oleracea* L.), foxtail (*Setaria lutescens* Hub.), and redroot (*Amaranthus retroflexus* L.) began to appear in the untreated flats and to a much lesser degree in the flats containing 1 ppm of 2,4-dichlorophenoxyacetic acid. No weeds appeared in any of the flats treated at either 10 or 100 ppm of the chemical.

In order to test the residual effect in the soil, four weeks after treatment, bean and pea seeds were planted in the flats that had been treated at 10 and 100 ppm of 2,4-dichlorophenoxyacetic acid. The seeds germinated, and the plants grew normally.

In trials with 2,4-dichlorophenoxyacetic acid on manure, seeds of rape, rye grass, field pea, brome grass, meadow fescue, creeping bent grass, orchard grass, hairy vetch, and alsike clover were added to the manure in large numbers to insure their presence. The manure was then divided into three lots. One lot was treated at 10 ppm with 2,4-dichlorophenoxyacetic acid, a second was treated at 100 ppm and a third was left untreated as a check. The manure was then mixed with sand, the final mixture being about one part of manure to two parts of sand. The mixture was placed in metal flats and kept moist in a warm greenhouse. After three days, seeds in the control lot began to germinate, and after two weeks the surface of the mixture was covered with plant growth. The germination of seeds in the treated flats at 10 and 100 ppm was greatly inhibited, only a few of the grasses appearing in the 10 ppm flat.

Treatment with 2,4-dichlorophenoxyacetic acid is suggested as a method of controlling weed seed in manure and muck soils and where these materials are used in top dressings of lawns and golf courses. This treatment may also be of special value in conditioning nursery, tobacco, and other seed beds before planting.

References

1. HAMNER, C. L., and MOULTON, J. E. (To be published.)
2. HAMNER, C. L., and TUKEY, H. B. *Science*, 1944, **100**, 154–155.
3. HAMNER, C. L., and TUKEY, H. B. *Bot. Gaz.*, 1945, **106**, 282–245.

Herbicidal Action of 2,4-Dichlorophenoxyacetic Acid on the Water Hyacinth, *Eichornia crassipes*

E. M. HILDEBRAND
Food Machinery Corporation, Dunedin, Florida

The water hyacinth, *Eichornia crassipes*, is a native of Japan and was carried about 70 years ago to South America, where it became widespread in fresh-water streams and lakes. At the International Cotton Exposition, held in New Orleans in 1884 (*1*), the Japanese government representatives gave away as souvenirs water hyacinths they had imported from Venezuela, where this pest had practically "taken over" the lower Orinoco. Very shortly thereafter the plant was introduced into Florida. Because it propagates prodigiously by both seeds and offshoots and matures two and sometimes three crops in a single season it presents a real problem in Florida and other subtropical regions, clogging the waterways, drainage ditches, and lakes.

Hildebrand and Palmiter (*3*) successfully employed the ammonium sulfamate herbicide for combating the *Prunus virginiana* wild host of the yellow-red virus disease of peach. Gowandloch (*1*) reviewed the various methods (chemical control, control by flame thrower, mechanical control, biological control) that have thus far been tried for water hyacinth control. He tested ammonium sulfamate and sulfamic acid for eradicating the water hyacinth and found that these killed only the plant parts above water.

Zimmerman and Hitchcock (*6*) developed some of the growth substances that may be toxic to plants in concentrations greater than that used to secure desirable responses such as rooting. Some of the more potent of these compounds are the substituted phenoxy compounds, one of which, 2,4-dichlorophenoxyacetic acid (2,4-D), has received considerable attention as a herbicide.

Hamner and Tukey (*2*) reported on the herbicidal action of 2,4-D on bindweed, *Convolvulus arvensis*, and on a number of other plant weeds. They also found the related compound, 2,4,5-trichlorophenoxyacetic acid, showing promise as a herbicide. In this and in subsequent study by others (e.g. *4, 5*), 2,4-D worked best on broad-leaved plants.

In April 1945 the writer first tested 2,4-D (1:1430) for eradicating the water hyacinth in a flowing stream of water. In preliminary trials promising results were obtained by spraying with a knapsack sprayer from the shore. Three areas, each involving several hundred plants, were treated. The amount of material employed was about one gallon per 100 square feet for plants about 15 inches tall. One week after application the upper parts were epinastic and discolored. By the end of two weeks both the above- and below-water parts were nearly all dead, the stems separating from the roots, and the dead parts disappearing in the stream either by sinking or floating away within three weeks.

In the second experiment several irregular patches of water hyacinth plants, which were partially clogging the creek, were sprayed from a boat with 2,4-D (1:1140). As in the previous experiment, the above-water parts were well moistened with a coarse spray until dripping started. Again the sprayed plants died and disappeared in the stream in about three weeks.

A third experiment, a repetition of the second in most details, gave similar results. The 2,4-D chemical plus Carbowax 1500, according to the formula of Hamner and Tukey (*2*), was employed. This preparation seemed to give an improved surface coating on the hyacinth foliage. However, practically 100 per cent kill was obtained, and the sprayed specimens disappeared in the stream in the treated areas, whereas the untreated check plants remained normal and in place. These studies seemed to have demonstrated the feasibility of removing the water hyacinth from streams.

Small fingerling fish and other water fauna were abundantly present among the water hyacinth growths before, during, and after spraying with 2,4-D. No adverse effects to the water fauna were observed up through the time of disappearance of the plants at the end of the experiments. Since 2,4-D is a growth substance for plants which operates on the "hormone" principle, injurious effects to water fauna were not anticipated or encountered from its use.

Starting early in October a second series of experiments was conducted for eradicating water hyacinths growing in relatively quiet water, in a rectangular, excavated pond with water ranging from 4 to 8 feet deep. The water hyacinths invaded this pond through a small drainage ditch and covered the surface in a few months time. The growth was vigorous, dense, 16 to 24 inches tall, and in bloom at the start of the experiment. One-gallon quantities of 2,4-D spray ranging in concentration from 1:800 to 1:1700, when applied in 100-square-feet plots and replicated three times, all gave practically complete control. The use of Carbowax as a wetting agent did not seem to improve the herbicidal action of 2,4-D. When the spray concentration (1:1000) was held constant, one gallon gave complete control for areas ranging from 100 to 150 square feet. In another experiment where both the concentrations and areas treated were varied, one gallon of 2,4-D (1:1700), when applied to plots 150 square feet in area, failed to give complete control, although over 90 per cent kill was obtained. In one experiment when rain fell before the 2,4-D spray had time to dry or be absorbed, the herbicidal action was largely lost.

The first conspicuous symptom of herbicidal action, consisting of an abrupt epinasty or downward bending of the upper part of the leaf petiole, appeared about two days after spray application. Subsequently discoloration and death occurred in about three weeks. Although chlorotic and decomposing, the last part to remain floating was the buoyant, enlarged, lower portion of the petiole. By the time the plants were dead in the treated plots the surrounding growth was moving in to occupy the vacated space. Therefore, to control the water hyacinth all the plants in a given area, rather than small portions of an area, must be sprayed.

In order to study the more intimate details of the effects of 2,4-D, another series of experiments was conducted during the winter, employing open, 50-gallon drums to which 12 to 20 plants were transferred. The first experiment consisted in spraying the plants in three drums with 2,4-D (1:1000) at three successive weekly intervals starting the last week in November. The plants in four drums were held as checks. The sequence in symptom development of previous experiments was repeated and confirmed, but the rate or speed of herbicidal action was slowed by over two weeks. Here, however, all plants died, decomposed, or settled to the bottom. Various forms of water fauna, including mosquitoes, were present in abundance, as was duckweed.

The second and final drum experiment was started in February and concluded in March. Around 25 small hyacinth plants about 4 inches tall were placed in each drum. Five different sources of 2,4-D, diluted 1:1000 and including one of the acid form, two salts of the acid, and two esters of the acid, were each applied to the plants in two drums, leaving three checks. Because of the smaller size of the plants, the rate of herbicidal action was increased over that of previous experiments with larger plants. The roots did not die and decompose as rapidly as the stem portion, yet they appeared to have lost the power to produce offshoots. As the result of this study, the form of the 2,4-D preparation used seemed to make no difference in herbicidal action provided the leaves were well moistened and the 2,4-D spray allowed to dry and penetrate into the leaves.

The possibility that important waterways might be cleared of the water hyacinth by means of 2,4-D invites trial on a larger scale. The "Water Buffalo" amphibian tractor might be useful in this connection.

References

1. Gowandloch, J. N. *La. Conservationist*, 1944, **2**(9), 3, 6, 8.
2. Hamner, C. L., and Tukey, H. B. *Science*, 1944, **100**, 154–155.
3. Hildebrand, E. M., and Palmiter, D. H. *Proc. N. Y. St. hort. Soc.* (87th annual meeting), 1942, 34–40.
4. Marth, P. C., and Mitchell, J. W. *Bot. Gaz.*, 1944, **106**, 224–232.
5. Mitchell, J. W., Davis, F. F., and Marth, P. C. *Turfdom*, October 1944.
6. Zimmerman, P. W., and Hitchcock, A. E. *Contr. Boyce Thompson Inst.*, 1942, **12**, 321–348.

Science Legislation

Selective Service and Student Personnel

Howard A. Meyerhoff

Executive Secretary, AAAS, Washington, D.C.

The recruitment of scientific and engineering students has just been dealt another blow by Selective Service and the Army—and perhaps by Congress, which may approve the extension of Selective Service for another nine months before this issue of *Science* reaches its readers. The bill extending Selective Service, by providing for the deferment of farm hands, will lay an especially heavy hand upon the students in our colleges and universities. If it passes in its present form, any hope that engineers and scientists may have had to recoup some of the losses incurred through the draft during the war will be gone for another year.

As every engineer and scientist knows, considerably more than 100,000 potential scientists were sacrificed during the war years, thanks to a military policy which made no provision whatever for the replacement of expendable scientific personnel. Neither our allies nor our enemies in the late war were as shortsighted as this, for most of them provided deferment for students who were specializing in scientific and engineering studies, and some of them encouraged new students of draft age to enter these professions. In dismal contrast to other nations, we not only drafted our prospective scientists and engineers, but also assigned them to military duties quite unrelated to the training which most of them had acquired. The Navy seems to have taken into account the special ability of students in so far as their training might prove useful, but the Army quite commonly showed a complete disregard of any background which even advanced students in specialized fields had acquired. This statement can be supported by the citation of any number of examples, but a quotation from one of several letters from young scientists will demonstrate the flagrant waste of scientific personnel, for which the Army must assume responsibility:

> So, with ten years of scientific training in biology, I was turned back to menial work (in an army hospital laboratory), most of which could be performed by a janitor. What with floor-mopping, latrine-cleaning (barracks and laboratory), window-cleaning, and scouring of glassware, three-fourths of one's time was spent on the sort of tasks for which any rookie chosen at random could be trained in one week.

There is in Army and Selective Service circles the bland assumption that returning veterans are filling in the gaps created by war, and letters from General Hershey addressed to the office of the Permanent Secretary reveal the lack of a factual basis for such an assumption. On 20 February he wrote:

> I am fully aware of the importance of the student group in which your Association has a vital interest. The technical, scientific and professional fields should be given due credit for their important contributions in the winning of the war and for the part they will play in the future.
>
> Veterans and other students are now entering college and university in very large numbers. They are studying at all levels ranging from the freshman class through graduate work. There is reason to believe that the rapid upward trend in enrollment will continue for some time. Engineering, scientific and professional study occupy a

prominent place in a very large number of colleges and universities, and these fields of study are now attracting many veterans.

Large numbers of colleges of all types, located in various sections of the country, report they already have capacity enrollments and that their ability to take care of additional students is limited by housing, staff, laboratory and classroom shortages. Many of these institutions are deeply concerned about the students who cannot be admitted because of the limited facilities. Temporary expedients are under wide discussion and some emergency arrangements have already been developed.

The situation is so critical that many special conferences are being called to consider the problem. State officials as well as colleges and university associations are urging that immediate steps be taken to provide educational opportunities for veterans and others now desiring admission.

In view of the present conditions, the problem seems to be that of accommodating the available and qualified students. If those entering are not pursuing the proper fields of study or courses, it would appear to be a matter of channelling them into the critical fields of study and where the best vocational opportunities exist.

The facts of the situation hardly warrant General Hershey's optimistic statement that "these (scientific) fields of study are now attracting many veterans." The statistics of enrollment for 110 engineering schools and colleges as of December, shown in Table 1, are eloquent.

TABLE 1

	Freshmen		Sophomores		Juniors		Seniors	
	N	%	N	%	N	%	N	%
Prewar norm	34	100	24	100	20	100	15	100
December 1945	32	94	12	50	7	35	4	27
Nonveteran	23	67	8	33	5	25	3	20
Veteran	9	27	4	17	2	10	1	7

Totals for all four years of engineering training may be summarized as shown in Table 2.

TABLE 2

	N	%	Veteran %
Prewar norm	93	100	...
December 1945	55	59	100
Nonveteran	39	42	71
Veteran	16	17	29

As of April 1946, the ratio of veterans to nonveterans has changed, but not for the reason that General Hershey thinks. Deferment was granted to civilian students until the end of the fall semester and was then withdrawn. The net result was to increase the proportion of veterans but to reduce the total of engineering students.

Probably the most interesting statement in the letter quoted is the concluding sentence. One wonders how veterans recently discharged from military disipline can be "channeled" into the critical fields of study, or why nonveterans who have chosen to enter these same "critical fields" should be "channeled" out, especially when they are far more critical to national security than the recruitment of approximately 20,000 men for military service.

Surely, it is not too much to ask military authorities to keep a vital long-range need in mind while solving two very temporary, if acute, problems. Or, if military authorities are incapable of dealing with so many problems simultaneously, it is not unreasonable to demand that the solution be placed in the hands of some authority able to effect it. Competence in engineering and science requires years of study and more years of experience. The war has cut our roster of scientific and technological manpower at least 12 per cent, and it is now proposed, not merely to prevent recovery, but also to cut the percentage farther.

As this article goes to press, the House is debating the bill. Representative May, chairman of the House Military Affairs Committee, introduced an amendment in Committee providing some protection for students, but it was voted down. Representatives Clason and Martin (of Iowa) introduced and supported a similar amendment on the floor of the House, but its fate is at the moment unknown. The chances of defeat are better than even.

Do engineers and scientists propose to sit by and take another beating?

U. S. News and Notes

Henry K. Townes, Kenneth L. Sherman, and *Robert Simha* were honored by the Washington Academy of Sciences at a meeting on 21 March 1946 for their respective contributions to the biological, engineering, and physical sciences.

The citations read: Henry K. Townes, Bureau of Entomology and Plant Quarantine, Beltsville, Maryland, in recognition of his distinguished service in the morphology and taxonomy of the insect superfamily Ichneumonoidea; Kenneth L. Sherman, Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D. C., in recognition of his distinguished service in advancing the technique of atmospheric electric measurements; Robert Simha, National Bureau of Standards, Washington, D. C., in recognition of his distinguished service in the physical chemistry of high polymers and the theory of their physical properties.

Dr. David E. Green, research associate in the Columbia University College of Physicians and Surgeons, has won the first Paul-Lewis Laboratories Award in Enzyme Chemistry, it is announced by the American Chemical Society, which administers the award. Sponsored by the Paul-Lewis Laboratories, Inc., of Milwaukee, Wisconsin, the annual award of $1,000 and a bronze medal was established this year to stimulate fundamental research by young graduates of American colleges or universities in the field of enzymes.

Dr. Reinhold Rudenberg, inventor of the electron microscope, received the Stevens Honor Award for notable achievement in the field of Electron Optics upon the occasion of the seventy-sixth Anniversay Annual Dinner of the Alumni of Stevens Institute of Technology. Dr. Rudenberg, now Gordon McKay professor of electrical engineering at Harvard University Graduate School, is also consultant to the Farrand Optical Company of New York, where he is developing an electron microscope of advanced design.

Announcements

The Texas Academy of Science held its 1945 annual meeting on 8, 9, and 10 November at Baylor University, Waco, Texas. A total of 96 papers were presented. In the report of the president, Walter P. Taylor, the course was charted which the organization must follow if it is to assume its rightful responsibility in the advancement of scientific knowledge in Texas. The president as well as the vice-presidents in the several sections emphasized the desire to encourage the growth of the collegiate section in order to bridge the serious gap in the depleted ranks of the young scientists occasioned by the war. Among other things, it was urged that grants-in-aid and fellowships be established and that greater participation in the program and official capacities be permitted to encourage the younger members.

The following were elected Honorary Life Fellows: W. J. Battle, University of Texas; F. A. Burt, A. and M. College; and Wallace Pratt, of the Standard Oil Company.

The first issue of Science Illustrated, published by the McGraw-Hill Publishing Company, was released on 1 April. This is a new general magazine from the science point of view, with a printing order of 500,000 copies, a record for new publications.

The editorial director is Dr. Gerald Wendt, former science editor of *Time*. The medical and biological editor is Dr. Barry Commoner, formerly instructor of biology at Queens College, New York, and until recently a lieutenant in the USNR, engaged in research on aviation medicine.

The two new elements, 95 and 96, were given names by Glenn T. Seaborg at the meeting of the Physical and Inorganic Division of the American Chemical Society meeting at Atlantic City on 10 April. He recommended that 95 be called "americium" with the symbol, Am, after the Americas, and that 96 be called "curium" with the symbol, Cm, after the Curies. Dr. Seaborg also recommended that the soft "c" be used in the pronunciation of americium, but some of his hearers thought that it would not be long until the second "i" will be dropped and the pronunciation changed, in the United States at least, following the history of aluminium.

Several scientists have expressed the view within the past week that a plan for international control of atomic energy which hinged on a "denaturing" process (*Science*, 1946, **103**, 428, 451) would not by its very nature be a successful one, and that the ultimate solution lay in the development of a strong organization for the control of nuclear energy.

The American Society of Agronomy and *Soil Science Society of America* held their annual meeting at the Deshler-Wallick Hotel, Columbus, Ohio, on 26 February to 1 March 1946 with over 635 registering. The first day was devoted to a report of the National Joint Committees on Fertilizer Application and Nitrogen Utilization. Highlights of the meetings were: (1) The general meeting at which "Opportunities and Responsibilities of Agronomists" were discussed. Dr. P. V. Cardon, of the Agricultural Research Administration, spoke on the "International Aspects" of the subject and Dr. Richard Bradfield, of Cornell University, on "Domestic Aspects"; (2) the annual banquet, at which Dr. F. W. Parker, president of the American Society of Agronomy, gave the presidential address on "The Nitrogen Problem in Soil Management," and at which members serving their country on special assignments during the war period were recognized. The remainder of the four-day meeting was taken up with general and special sessions on various phases of soils and crops.

The seventeenth annual Stuart McGuire Lecture Series given by Dr. Elmer L. Sevringhaus, professor of medicine at the University of Wisconsin Medical School, was combined with the spring postgraduate clinic at the Medical College of Virginia this year.

Meetings

The American Mathematical Society will hold its 415th and 416th meetings on 26–27 April at Columbia University, New York City, and the Museum of Science and Industry, Chicago, respectively. The 417th meeting will be held on 27 April at the University of California, Berkeley.

The Twentieth Colloid Symposium will be held at the University of Wisconsin, Madison, on 28–29 May 1946. As on the occasion of the First Colloid Symposium, which also met in Madison, Prof. The Svedberg, of the University of Upsala, Sweden, is to be the guest of honor.

One day of the meeting will be devoted to the topic: "The Physical Chemistry of High Molecular Weight Materials." Papers on this topic will be given at two concurrent sessions, one concerned with the proteins and the second with organic high polymers. Dr. Svedberg is to preside at the session on proteins, and Dr. Paul Flory, of the Research Department of the Goodyear Rubber Company, is in charge of the arrangements for the high polymer session.

On the second day a program of general papers has been planned by Dr. H. B. Weiser, with the cooperation of members of the Colloid Symposium Committee.

Arrangements have been made for housing at one of the University dormitories, and meals can be taken at the Commons. Those who expect to attend the Symposium should notify Prof. C. H. Sorum, Department of Chemistry, Madison, Wisconsin, before 20 May to insure accommodations. Rooms will be available for the nights of 27, 28, and 29 May.

Elections

The American Society of Agronomy has elected the following officers for 1946: H. D. Hughes, Iowa State College, president; W. H. Pierre, Iowa State College, vice-president; J. D. Luckett, New York Agricultural Experiment Station, editor; G. G. Pohlman, West Virginia University, secretary-treasurer; E. A. Hollowell, Bureau of Plant Industry, Soils and Agricultural Engineering, chairman of Crops Division; and C. E. Marshall, University of Missouri, chairman of Soils Division.

The Soil Science Society of America reports election of the following officers for 1946: C. E. Marshall, University of Missouri, president; F. L. Duley, University of Nebraska, vice-president.

Recent Deaths

Dr. Harold E. Robertson, 67, senior consultant in the Mayo Clinic section on pathological anatomy and former head of that section, died on 8 March.

Dr. William Morton Barrows, 62, professor of zoology and entomology at Ohio State University, died on 24 February. He had been associated with the University since 1909.

Dr. Bernice L. Maclean, 42, zoologist and former chairman of the Department of Biological Sciences at Hunter College, died in New York City on 8 March.

Mary B. Eyre, 70, professor emeritus of psychology at Scripps College and professor of psychology at the Claremont Graduate School, died on 25 January following injuries sustained in a traffic accident.

William Crowell Bray, 66, professor of chemistry at the University of California, died on 24 February following an illness of several months.

Carl L. A. Schmidt, 60, professor of biochemistry and chairman of the Division in the University of California Medical School for 23 years, died after a long illness on 23 February.

International News and Notes

L. H. Bailey and *A. J. Eames,* of Cornell University, and *E. D. Merrill* and *Frans Verdoorn,* of the Arnold Arboretum of Harvard University, have been elected honorary foreign members of the Botanical Society of Edinburgh.

Dr. Herbert Spencer Gasser, winner of the 1944 Nobel Prize in medicine and physiology, and since 1935 head of the Rockefeller Institute in New York, has been made a member of the Swedish Royal Academy of Science.

Dr. Arthur Stoll of Basle, Switzerland, director of the Sandoz Research Laboratories, is the recipient of an honorary doctorate, conferred by the Sorbonne for his fundamental contributions to the chemistry of the glycosides of digitalis and squill and for his work in the field of the alkaloids of ergot.

Robert S. Tipson, senior fellow in Pure Research at Mellon Institute, was awarded the D.Sc. degree by the University of Birmingham, England. The same degree was also awarded to another scientist, Owen W. Ellis, of the Ontario Research Foundation, Toronto, formerly an industrial fellow of Mellon Institute.

Dr. Cornelio L. Sagui (18 Rue Luchet, Avignon, France) writes to Dr. Charles H. Behre, Jr., professor of geology at Columbia University, that geology in France is once more beginning to resume its normal peacetime role, one of its most prominent functions being in the field of reconstruction. The Association International pour l'Etude Scientifique des Pays Mediterraneans is in process of being organized, and some of its problems will lie in the fields of general and economic geology. Dr. Sagui is studying and publishing in several fields. One of his most recent investigations concerns the pressure of magma in intrusive bodies. Fernand Blondel, well known in this country as a Fellow of the Geological Society of America and as a member of the Society of Economic Geologists, has just returned to Paris (24 Rue Vineuse) after prolonged service in French North Africa. Dr. Jean F. Orcel (61 Rue de Buffon) has resumed his post of curator in mineralogy at the Museum National d'Histoire Naturelle. Dr. Gaston Betier is back at his post in Algeria. Mr. J. Durand, still with the Bureau des Mines in Toulouse, has been stationed at intervals at Saint Gaudens, where he has been directing special research on petroleum for the Government.

In Belgium, Prof. Ivan De Magnee writes through Dr. Sagui, theoretical and applied geology are being pursued with renewed vigor. Prof. De Magnee at the University of Brussels (15 Rue des Nations, Bruxelles) has founded a laboratory for geophysical research, in part directed toward new prospecting in the Congo. Prof. Paul F. Fourmarier, after imprisonment by the Gestapo, is once more at his old post at the Institut de Geologie, University of Liège, as is Prof. Victor Brien.

Dr. M. S. Krishnan, superintending geologist of the Geological Survey of India, comments on the difficulties of the war years, among which was a serious paper shortage which cut to about a third the volume of scientific and technical publications. He adds, however, that there are signs that publication will be resumed shortly on the old scale.

Dr. Wallace P. Cohoe, a consulting chemist, 120 East 41st Street, New York, will receive the Messel Medal of the Society of Chemical Industry at the annual meeting of the Society in England on 12 July 1946. In the Messel Lecture he will discuss "The Importance of Science in Anglo-American Relationships."

The Messel Medal is awarded every other year for meritorious distinction in science or in the literature of chemistry or for meritorious service to chemical industry. Two other Americans have received the Messel Medal, Prof. R. A. Millikan in 1928 and Dr. Leo H. Baekeland in 1938. The other 10 recipients, all English, were: Prof. H. E. Armstrong, Rt. Hon. Viscount Leverhulme, Rt. Hon. Earl of Balfour, Rt. Hon. Lord Brotherton of Wakefield, Sir William J. Pope, Sir Harry McGowan (now the Rt. Hon. Lord McGowan), Sir Robert Mond, Rt. Hon. Viscount Samuel, Sir John Russell, and Prof. A. V. Hill.

Dr. Pierre Bonnet, of the Laboratoire de Zoologie, Université de Toulouse, France, writes that he is well in spite of having had some narrow escapes during the bombings. Working under difficulties, he has continued to amass material for his three-volume ***Bibliographia Araneorum,*** the first volume of which appeared off the press last September. It is a volume of 830 pages and contains 106 portraits of past and present workers in the field of araneology. He also writes that Dr. J. Denis is still at Donchy, and Profs. L. Fage, L. Berland, and J. Millot are still in Paris. All are anxious to receive the publications of their American colleagues.—*B. J. Kaston* (Syracuse University).

Prof. Yun-Pu Liu, organic chemist, who was in the United States as a research fellow of the China Foundation and of the Rockefeller Foundation from 1931 to 1934, receiving his Ph.D. at the California Institute of Technology, writes that he is now teaching in the National University of Chungking. He states that the Chinese Ministry of Education has recently announced that university professors with seven years of service may apply to go to the United States or England on an exchange basis, provided they can secure some kind of appointment, such as research work or teaching jobs by their own arrangement. The Ministry is to pay only the traveling expenses of such individuals. Prof. Liu is among those eager to obtain a suitable appointment in the United States.—*Maurice L. Huggins* (Eastman Kodak Company).

Dr. Luigi Provasoli, of Italy, whose work in the nutrition of green and colorless flagellates is well-known in the field of comparative physiology, writes that he has been isolated from American research literature for the past six years, and that it is still very difficult to secure scientific books or journals in Italy. He would appreciate it very much if the authors of papers dealing with the nutrition of Protozoa could send him their reprints. His address is: Universitá, Camerino, Italy.

Dr. Provasoli feels that he and his family came through the war in a relatively fortunate manner. He experienced only a brief period in a concentration camp. He has not yet been able to return to his prewar position at Milan because conditions in that city are hardly conducive to scholarly work: electricity is available about every other day, gas for two hours a day, and wood is so scarce and expensive that heat is almost unknown.

As Dr. Provasoli says, let us "hope that the few men of good will will succeed to make fully understood that our safety is only in a united world policy and in the strong and truthful building of an organization governing the entire world.—*William Trager* (Rockefeller Institute, Princeton, New Jersey).

Prof. C. Bonne, head of the Department of Pathology in the Government Medical School in Batavia, has written to Dr. Morris E. Dailey, University of California Hospital, San Francisco. Portions of his letter, dated 12 February 1946, follow:

> The European staff members of the School have all been interned by the Japanese, most of them, including myself, for three and one-half years. I am recuperating now in Australia with a few of my colleagues; others have gone to Holland and others are still in Java. Many of us have been severely ill, but there were no deaths amongst us. In January this year the Medical School was still in the hands of the Indonesians. School and hospital did not suffer much damage mainly due to the wise cares of our Indonesian assistants. I hope to be able to resume my work in my old position when a settlement between the Dutch and Indonesians is reached.

Prof. Bonne's present address is: c/o Mrs. J. Bonne, Main Avenue, Coorparoo, Brisbane, Queensland, Australia.

An international conference, called by the executive committee of the International Astronomical Union, met in Copenhagen on 7-11 March. The American delegation—Harlow Shapley, director of the Harvard University Observatory; Otto Struve, director of the Yerkes Observatory of the University of Chicago and of the McDonald Observatory of the University of Texas; and Joel Stebbins, director of the Washburn Observatory of the University of Wisconsin and a research associate of the Mount Wilson Observatory at Pasadena, California—left the United States on 2 March, flying from La Guardia Field.

The more precise determination of star positions was one of the matters considered at Copenhagen. This conference is expected to redistribute international services that were assigned to Germany, wholly in German hands, for the interwar period. It is likely that Russia will take over one or two of these service bureaus, which deal with planetary motions, with variable stars, and with the international time services.

In the Laboratory

Inhibition of Fungus Respiration: a Metabolic Bio-assay Method[1]

Walter J. Nickerson, Lt., Sn.C.
Air Forces Proving Ground Command
Eglin Field, Florida

In the search for chemical substances active against disease-producing organisms, one is frequently confronted with difficulties in establishing criteria for activity. In a stimulating series of papers on the principles and practices of laboratory testing of fungicides, McCallan and Wilcoxon (*7*) bring out the close relationship of bio-assay methods in general and speak of two categories of assays: (1) that in which the effect of a toxic agent on an organism is *measured* quantitatively, and (2) that in which some phenomenon in the form of a "response" (an event either does or does not happen) of an organism is *observed*. Nearly all bio-assay methods for fungicides and bacteriocides in current use are examples of Type 2. Among these may be mentioned the various spore-germination tests and the U. S. Food and Drug Administration methods (*11*) for testing antiseptics, wherein the highest dilution of a chemical completely inhibiting growth is observed. The agar cup-plate methods, utilized in penicillin assay, are further examples, since one determines essentially a zone of concentration which inhibits growth.

While observations of certain responses of an organism, *i.e.* the germination or nongermination of spores, growth or absence of growth, have provided much valuable information on antiseptics, disinfectants, and substances with chemotherapeutic activity, need is felt at times for methods that will reveal the extent to which a foreign agent affects a healthy, growing culture. This is particularly true with the pathogenic fungi. We know of chemicals that keep spores from germinating or prevent fungus mycelia from entering a zone of given concentration of chemical on an agar plate. However, in spite of several studies on the correlation between laboratory and clinical findings, our information on what (to say nothing of the mechanism whereby) the chemicals do to "adult" fungi is extremely scanty. In the treat-

---

[1] The author appreciates the interest and aid of Dr. J. G. Hopkins, Lt.Col. Laurence Irving, and Lt.Col. J. R. Scholtz in the work reported here and to be described.

ment of fungus infections we are primarily concerned with the removal of an established parasite and secondarily with prevention of reinfection. Information from "response" tests is directly applicable to considerations of reinfection but only indirectly to an existing infection. It is clear that all fungus infections are not acquired via the fungus spore; indeed, the mode of transmission of fungus infections is far from being clearly explained with some evidence incriminating mycelia contained in skin debris as the infecting agent. Though fungus spores are notoriously resistant, it does not follow that treatment which prevents their germination will also be lethal to mycelial fragments (capable of growth) contained in skin debris in which the protective action of tissue and other factors are possibly operative.

The present unsatisfactory state of treatment for fungus infections may, in part, reflect our lack of satisfactory methods for testing *in vitro* the effects of chemicals on the fungus in a state of organization comparable to that *in situ*.

In view of the foregoing, convenient methods furnishing quantitative data on the immediate effect of a chemical on a mycelial organization of a fungus would be welcome. It is shown that such may be found in quantitative measurements of oxygen consumption by fungus cultures or samples therefrom; the methods may be extended to fungus mycelia contained in skin debris.

Cultures of pathogenic fungi freshly isolated from foot lesions were identified following Emmons (*5*), and Conant, *et al.* (*2*). These cultures and cultures of fungi received from Duke University Medical School[2] were inoculated onto plates of Sabouraud's dextrose agar and Difco-cornmeal agar. Transfers were also inoculated into a liquid medium. The following organisms were used: *Trichophyton gypseum, T. rubrum,* and *Epidermophyton floccosum.*

The filamentous fungi grow in the form of a mat on the surface of agar media and, unless disturbed, grow similarly on the surface of liquid media. Attempts to harvest such growth and to homogenize it in some way (such as by sucking in and expelling from a syringe) for use as a suspension have been reported occasionally, but such techniques defeat the purpose; the mycelial components are usually ruptured and one most often obtains merely a spore suspension. Using a sterile cork borer of 15-mm. diameter, cylinders were cut from agar-plate cultures, two or four weeks old. The discs were placed in a respirometer in 1 cc. of liquid. It made no difference whether the disc was placed so that the mycelial side or the agar side was face down in the liquid. After the experimental period in the respirometer the disc was dropped into boiling water to remove the agar, lifted from the water after 1 minute, drained, and placed on a previously weighed, clean, dry cover slip. Dry-weight determinations were made by heating the fungus and cover slip for 12 hours at 100° C. Loss of weight by the fungus mycelium during the brief hot-water extraction was found to be negligible. After the drying and weighing the cover slip and fungus were mounted, in lactophenol cotton blue, on a slide to give a permanent record of the organism used in each experiment. With this record, contamination, if such occurred, would be easily discovered. Samples of fungus from liquid cultures were obtained simply by use of a wire, flattened at the end to a sharp cutting edge capable of being flamed. Pieces of mycelium were lifted out, drained, rinsed in sterile distilled water, and placed in 1 cc. of liquid in the respirometer vessel.

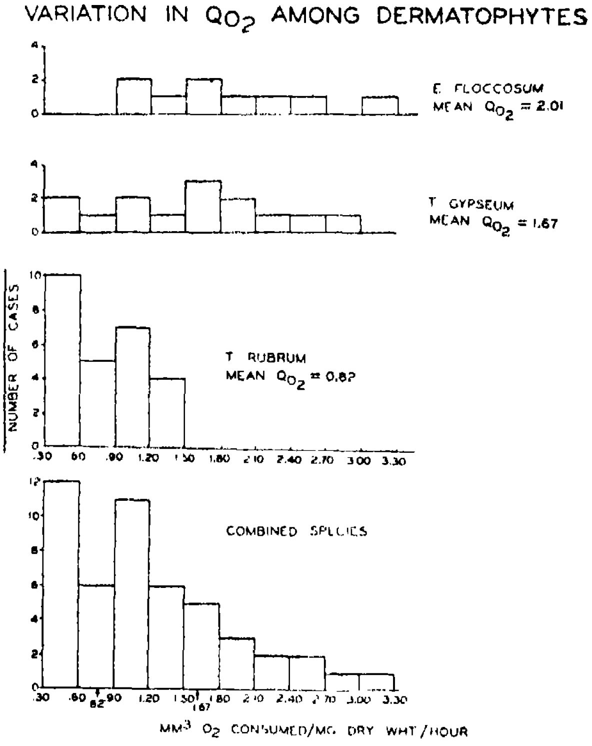


FIG. 1

A volumetric microrespirometer described by Scholander and by Scholander and Edwards (*9*) was used in the present work.[3] This instrument, discussed by Glick (*6*), employs an ordinary micrometer to displace mercury from the reservoir of a Rehberg-type microburette and has a sensitivity of 1/3 mm.³/hour. An important feature of the instrument is that the pressure of oxygen in the vessel is maintained constant during long experiments.

---

[2] The kindness of Dr. N. F. Conant in supplying cultures of organisms is appreciated.

[3] It is a pleasure to acknowledge the helpful discussion with Major P. F. Scholander and Lt. G. A. Edwards during the course of this work.

The influence of several classes of chemical substances under different environmental conditions on the oxygen consumption by species of dermatophytes will be reported elsewhere (*8*); a few examples will suffice here. Variation in the Q_{O_2} (mm.^{3} O_2 consumed/mg. dry weight/hour) among isolates of the three species examined is shown in Fig. 1. Four of the values given for *Trichophyton gypseum* are for oxygen consumption in distilled water; for the other two species all values were obtained in M/15 KH_2PO_4 buffer at pH 4.6; no substrate or other chemical was added in any case. After a preliminary equilibration period, the rate of oxygen consumption for all organisms examined was linear for several hours. The mean Q_{O_2} of 0.82 (26 cases) for *T. rubrum* sets it somewhat apart from the other species examined.

TABLE 1

EFFECT OF INORGANIC SALTS ON OXYGEN CONSUMPTION BY DERMATOPHYTES

Compound	Concentration	Organism	Change from Q_{O_2} in M/15 KH_2PO_4 buffer at pH 4.6
			%
$ZnCl_2$	10^{-2}M	*E. floccosum*	− 93
$ZnCl_2$	10^{-3}M	*T. rubrum*	− 82
$Zn(NO_3)_2$	10^{-3}M	"	− 22
$ZnCl_2$	10^{-4}M	*T. gypseum*	− 13
$CdCl_2$	10^{-3}M	*T. rubrum*	− 22
$CdSO_4$	10^{-2}M	"	+ 37
$AgNO_3$	10^{-3}M	"	− 100
$AgNO_3$	10^{-4}M	"	− 43
$HgCl_2$	10^{-3}M	"	− 74
$HgCl_2$	10^{-5}M	"	− 28

Certain inorganic water-soluble salts were examined for effect on fungus respiration. As will be seen in Table 1, mercury, silver, and zinc in similar concentrations depressed respiration to a comparable extent; cadmium compounds had little effect. Addition of 1/100 molar sodium propionate to *E. floccosum* in M/15 KH_2PO_4 buffer resulted in three experiments in inhibitions of 13, 27, and 35 per cent, respectively, of the basal Q_{O_2} in plain buffer. Removal of the propionate by washing with buffer and return of the fungus to buffer was followed in each of the three cases by a rise in the Q_{O_2} to the initial basal rate in plain buffer. Exposure of *E. floccosum* to 1/100 molar zinc chloride for three hours was not followed by recovery in the Q_{O_2} when the salt was removed; the fungus was incapable of further growth when transferred to an agar medium after such treatment.

Clinical trials with dilute (1 per cent) solutions of zinc chloride showed it to be of promise in the treatment of tinea cruris and tinea glabrosa. A report on this work is in preparation (*3*).

The use of respiration studies in connection with problems of skin infection has been advised before. Bronfenbrenner, Hershey, and Doubly (*1*) and Ely (*4*) advocated use of manometric methods for evaluation of germicides, but few publications have appeared in this vein. It is believed from the present study that the uncovering and evaluation of substances for chemotherapeutic use in fungus infections by determination of their effect on fungus respiration is a practical and desirable procedure. Chemical substances proposed as fungicidal or fungistatic agents can easily be subjected to critical test through measurement of inhibitory action on fungus respiration.

Though the metabolism of the pathogenic fungi is practically unknown, it is realized that inhibition of oxygen consumption may be an insignificant matter with some species if the organism in question happens to employ hydrogen acceptors other than oxygen for the bulk of its metabolism. Sevag, Richardson, and Henry (*10*) have stated this problem very clearly in their studies on the mode of action of sulfonamides on the respiration of bacteria. With the species herein discussed, oxygen consumption is apparently a critical index of metabolism and inhibition of respiration a valuable *in vitro* criterion of the effect of chemotherapeutic agents on these organisms.

The application of the method presented is not limited to the dermatophytes. One can apply it to the fungi causing deterioration of textiles and other equipment in wet tropical climates. A small sample of cloth infected with an assortment of organisms may be placed in a respirometer and the oxygen consumption of this *microcosm* measured. Various chemicals may then be added and their comparative inhibitory effect on respiration noted. This procedure would enable one to determine the effect of treatment on a mixed population in which synergistic phenomena are doubtless in operation.

In actuality, any situation in which mycelial growth of fungi needs to be controlled could profit from the application of metabolic criteria to the activity of a fungicidal or fungistatic agent.

References

1. BRONFENBRENNER, J., HERSHEY, A. D., and DOUBLY, J. A. *Proc. Soc. exp. Biol. Med.*, 1938, **38**, 210.
2. CONANT, N. F., MARTIN, D. S., SMITH, D. T., BAKER, R. D., and CALLAWAY, J. L. *Manual of clinical mycology.* Philadelphia: Saunders, 1945.
3. DOLCE, F. A., and NICKERSON, W. J. (In ms.)
4. ELY, J. O. *J. Bacteriol.*, 1939, **38**, 391.
5. EMMONS, C. W. *Arch. Derm. Syph.*, 1934, **30**, 337.
6. GLICK, D. *Annu. Rev. Biochem.*, 1944, **13**, 705.
7. MCCALLAN, S. E. A., and WILCOXON, F. *Contr. Boyce Thompson Inst.*, 1934, **6**, 479; 1939, **10**, 329; 1939, **11**, 5.
8. NICKERSON, W. J., and CHADWICK, J. B. (In ms.)
9. SCHOLANDER, P. F. *Rev. sci. Instr.*, 1942, **13**, 32; SCHOLANDER, P. F., and EDWARDS, G. A., *Rev. sci. Instr.*, 1942, **13**, 292.
10. SEVAG, M. G., RICHARDSON, R. A., and HENRY, J. *J. Bacteriol.*, 1945, **49**, 129.
11. U. S. DEPT. AGRIC. CIRCULAR 198, December 1931.

Letters to the Editor

Effects of New Herbicides on Fish

During the course of some experiments to determine the effects of certain of the new herbicides on fish, we set up some tests, largely out of curiosity, using the new rodenticide 1080. In view of the extreme toxicity of this substance, as reported by E. R. Kalmbach (*Science*, 1945, **102**, 232), we were certainly surprised to find that fingerling bream and bass would survive in concentrations of 1080 as great as 370 ppm for an indefinite period and with no apparent discomfort.

JOSEPH E. KING
U. S. Fish & Wildlife Service, New Orleans
WILLIAM T. PENFOUND
Tulane University, New Orleans

Some Reflections on the Cause of Heat and Cold

Not many Americans know of M. V. Lomonósov, a noted Russian scientist, and very few are aware of the scope of his research. The writer of this article wishes to pay tribute to this great early Russian physicist, one of the first academicians of the Russian Academy of Sciences, for his research in the theory of heat.

M. V. Lomonósov's name has never been mentioned in the West-European and American scientific literature in connection with the development of our concept of heat, although he, as early as the first half of XVIII century, did not believe in phlogiston, but that heat is a kind of motion of constituent particles within a body.

In his dissertation under the title "Some Reflections on the Cause of Heat and Cold," read 21 and 25 January 1745 at a session of the Russian Academy of Sciences, Lomonósov had two paragraphs which I translate and quote (B. N. Menshutkin. *Works of M. V. Lomonósov in physics and chemistry.* Moscow-Leningrad: Academy of Sciences of the USSR, 1936. Pp. 109, 110).

"A body A which acts upon a body B cannot add to the latter a greater velocity than that which it itself possesses. If, therefore, the body B is cold and immersed in a warm gaseous body A, the heat movement of the particles of the body A brings the particles of the body B into a heat movement, but it cannot induce in the particles of the body B a greater speed than that which is present in the particles of the body A. Therefore, the cold body B being immersed in the body A cannot perceive a greater degree of heat than that which the body A has."

". . . Furthermore, one cannot mention some definite velocity, a such one that someone else could not visualize mentally another, a greater velocity. This, of course, should be referred to the heat motion also: therefore, the highest and the last degree of heat is not a thinkable motion. *Vice versa*, the very same motion can decrease to such an extent that finally a body reaches a condition of an absolute rest—and no farther decrease in motion is possible. Consequently, by necessity, there should exist the greatest and the last degree of cold expressed in the complete rest of the particles, in the complete absence of their spinning movements."

In the first quotation Lomonósov expresses the Second Principle of Thermodynamics which was rediscovered and established 85 years later.

In the second he points out that there is no higher limit for temperature and gives an inference about the necessity for the lower limit of temperature—the absolute zero—a concept introduced into science about 1870, *i.e.* 125 years later. Even still further this self-made scientific genius goes: he defines the absolute zero as absence of the spinning movements of particles. Therefore Lomonósov's absolute zero temperature excludes even null-point energy due to the spin of electrons, and the theory of null-point energy based on Fermistatistics is a development of recent years; the measurement of temperature under zero null-point energy is yet among achievements of the future physics.

Paying this tribute I wish to reinstate that Miháilo Vasílievich Lomonósov developed his mechanical concept of heat in which an impossibility of heat transfer from a colder body to a warmer one, and the idea of the absolute zero temperature as a cessation of any kind of motion in or between the constituent particles of a body were incorporated far ahead of those scientists to which the discovery and the development of these two cornerstones of the contemporary thermodynamics were credited.

ANATOL J. SHNEIDEROV
The Johns Hopkins University

Science in the Albuquerque High School

I feel that Charles A. Gramet (*Science*, 1946, **103**, 149) has made some good suggestions as to how science enrollments might be increased in secondary schools. He feels that his own school system of Brooklyn, New York, gives a pretty good science education and that it need not feel inferior to challenges which come from colleges. I feel the same way about our schools, out here in the deserts of New Mexico.

I would like to make a few additional remarks about the nationwide decline in science enrollment in secondary schools. Here in our own school (Albuquerque High School) we require only one unit of science for graduation, anything taken above that is strictly on an elective basis. Back in 1930 I felt that such a requirement was inadequate but there seemed no way to promote additional requirements. Our school decided to go out and get the students, requirements or not. We could not use legal requirements, so we used other means to popularize the classes. These included advertising campaigns, an assembly or two, and a crew of physics students that carried scientific shows to our city and county grade schools.

The campaign bore fruit in a hurry. We believe now that we boast one of the largest science enrollments, on a percentage basis, in the Nation. Our school has an enrollment of a little more than 2,100 students, 1,300 of whom take science. It is seldom that we graduate a person without more than two years of science. We have 240 students in our physics classes, and we have had that great a per cent (11.4) for about 12 years. If the student wishes, he can satisfy his science requirement by taking biology as a sophomore. Almost 700 take the subject each year, but in addition we seldom graduate a student who has not taken, in addition, one of the other laboratory sciences such as chemistry, physics, or our year course in geology.

We have not popularized our courses just by making them easy. On standardized tests we consistently beat the medians, even though we do carry along a few poor students. We believe that we have gained support by supplying good courses as well as advertising. We have done some pioneering also. In 1935 we started a full-year laboratory course in geology. In 1937 we started semester courses in radio physics, air navigation, and meteorology. These three courses were "shots in the dark," but they paid off in numerous fighter pilots, radio technicians, weather observers, and navigators in the war.

I am not sure that we would now welcome any rules requiring more than one science for graduation. We do not need it, and under our present plan we get people who want to take the subjects without other pressure. Our school has about every sort of outside activity imaginable, and the classroom has plenty of competition for students. We have gained our large enrollment by rowing upstream, and we sort of like it that way. We are ever on the lookout for ways to make our courses more attractive and more useful, and we hope to go on competing with whatever other attractions arise.

E. R. HARRINGTON, *Head*
Science Department, The Albuquerque High School
Albuquerque, New Mexico

More Reversed Winter Flounders

In a recent article (*Science*, 1945, 102, 672–673) E. W. Gudger described three specimens of "left-handed" winter flounders in some detail and stressed the rarity of their occurrence. Various members of the staff of the Atlantic Biological Station, St. Andrews, New Brunswick, have made similar observations in the Fundy area that may be of interest to readers of *Science*.

On 2 August 1945 a reversed specimen was brought to the station by the fisherman who took it the previous day on a trawl set in the St. Croix River, opposite Robinston, Maine. He apparently recognized the fish as being a winter flounder and stated that he had heard of such curiosities from other fishermen but had never seen one himself until then. This fish, a female, measured 369 mm. in total length, and 283 mm. to the end of the last vertebra. The numbers of fin rays, body proportions, and other characters conformed to the specific description given by Bigelow and Welsh (*Bull. U.S.B. Fisheries*, 40, 472–507), and the fish appeared healthy and normal in all respects except for reversal.

Another reversed specimen of about the same size was on exhibit in the station museum, along with a normal one for comparison, for a number of years previous to the 1932 fire which destroyed the Biological Station.

Mr. E. G. Rigby, curator of the station, states that he has seen, in addition, several other specimens taken during the course of his 30 years service here. Dr. A. H. Leim, chief biologist, makes a similar report and refers to the capture of a "right-handed" specimen that was pigmented on both sides.

J. C. MEDCOF
Fisheries Research Board of Canada

A Circular Slide Rule

Science, 1946, 103, 113, describes a slide rule made by William E. Morrell for solving problems such as $d = \sqrt{x^2 + y^2 + z^2}$ and $r = \sqrt{x^2 + y^2}$, etc., using a pair of linear scales and a pair of square-root scales which differ from those of the ordinary slide rule in that they are graduated according to the square root of numbers on the linear scales instead of the square root of numbers on a logarithmic scale.

If two identical scales are used, graduated so that they show square roots of numbers on a linear scale, the operation of finding the square root of the sum of two squares is done more simply than on the slide rule described. The problem is solved as simply as performing a multiplication on a pair of logarithmic scales.

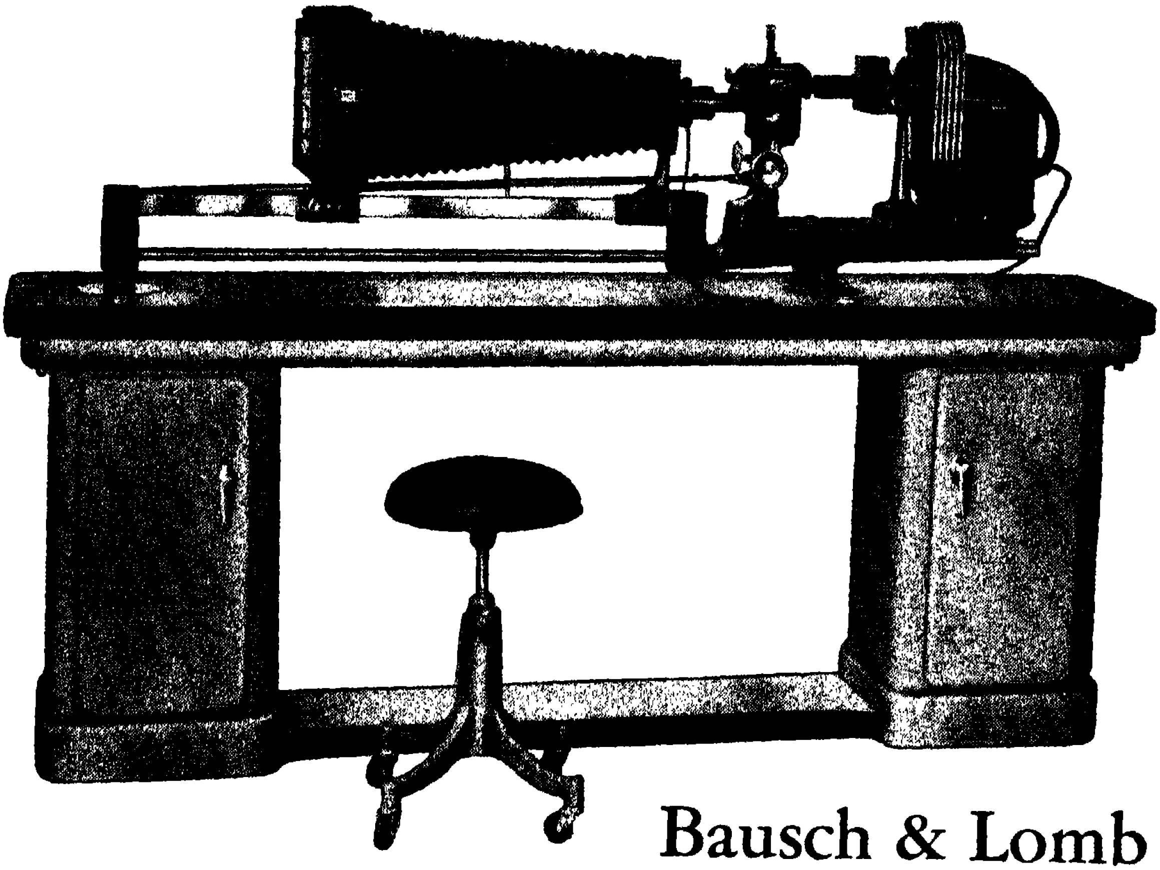
The Rotarule, a circular slide rule manufactured by this writer, has carried such a pair of square root scales since 1927, as well as a linear scale making it possible to solve $r = \sqrt{x^2 + y^2}$ and $c = a^2 + b^2$ with a minimum of effort.

J. R. DEMPSTER
2204 Glen Avenue, Berkeley 7, California

Reply to Prof. Chamberlain

Some years ago it was seriously propounded that all scientific research be banned in order to permit the world to catch up. All that would happen, of course, would be that we ourselves would remain stagnant, and the rest of the world would go ahead. Some such thought as this is suggested as a result of the reading of Prof. Katherine Chamberlain's article on "Another chain reaction" (*Science*, 1946, 103, 158–160), in which she suggests that all atomic bomb research be abandoned until a definite world understanding is reached regarding the use of this most powerful form of energy. I would suggest instead that the research be stepped up to double its present rate. Power is a force for good when used in the right hands, and right today we need some organization of the good forces, as Prof. Chamberlain indicates. The time is fast approaching when those who, in a democracy, do not take an active interest in public affairs will be deemed negligent.

ROBERT KERR DEWAR, M.D.
Fort William, Canada



Bausch & Lomb Metallographic Equipment

Whether it is to be used for visual observation or the photography of metal, the Bausch & Lomb ILS Metallographic Equipment provides an instrument easily adaptable to meet the major demands of metallography.

It is permanently aligned to insure the perfectly centered illumination required for good photographs. Specimens can be examined or photographed over a wide range of magnifications.

The many other features built into this instrument aid the metallographer in doing analytical work quickly and with a minimum of effort. For complete information send for Catalog E-29. Bausch & Lomb Optical Co., 642–4 St. Paul Street, Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

Book Reviews

Two-way radio. **Samuel Freedman. Chicago–New York: Ziff-Davis, 1946. Pp. xxii + 506. (Illustrated.) $5.00.**

This book treats of systems for two-way radio—that is, of systems for communicating between a fixed station and a mobile unit or between two mobile units. For this purpose both a transmitter and a receiver are necessary at each point.

The purpose of the book is to make clear the considerations which determine the choice of any particular system and to describe the necessary apparatus and its installation. The long experience of the author in microwave development and in the development of systems for ship and submarine communication and for police patrol enables him to speak with authority on the solution of such problems.

The book is not intended as a text on communications theory. Some small space, it is true, is devoted to an introduction to electric circuit theory and the propagation of electric waves, but the treatment is necessarily somewhat superficial. An occasional electronic circuit diagram appears, but no attempt is made to analyze its parts or to discuss its operation. The scope of the book is essentially general and descriptive, and the treatment of the central theme is thorough and masterly.

In the earlier chapters attention is paid to available power sources, types of antennae, and details of apparatus, both at the fixed and the mobile station. Chapters follow which deal clearly and exhaustively with the relative advantages and limitations of amplitude modulation, frequency modulation, induction and guided carrier systems, and possible future applications of microwaves to two-way radio. These chapters are particularly well done.

More than a hundred pages of the book are on two-way radio for railroads. In this discussion, considerable attention is paid to the arguments for and against the adoption of radio in place of visual signals. The author makes a strong case for radio as a supplementary and powerful auxiliary to the visual signal system, and considers at length the choice of radio systems applicable to the various complex problems of railroad operation.

The remaining shorter chapters on police, fire, and forestry systems, highway and public transport services, and marine and aeronautical applications deal with the special problems inherent in these services and not previously covered.

The book is well furnished with cuts of commercial apparatus and pictures of actual installations. The commercial aspects are not, however, unduly emphasized.

This is a mine of detailed information and should prove of value, not only as an aid in planning new projects but in furthering the application of radio in fields where its usefulness is just beginning to be appreciated.

Frederick W. Grover

Union College, Schenectady, New York

Sequential analysis of statistical data: applications. **(Prepared by Statistical Research Group, Columbia Univ., for Applied Mathematics Panel, NDRC.) New York: Columbia Univ. Press, 1945. 6 sections & appendices. $6.25.**

The procedure of sequential analysis is as follows: An item is drawn from the lot to be inspected, and it is inspected; on the basis of the evidence of the sample of one, (a) the lot is accepted, (b) the lot is rejected, or (c) the evidence is found to be insufficient for either decision. If decision (c) is reached, a second item is drawn and inspected, and on the basis of the sample, now of two items, the same three possible decisions are considered. This procedure is followed until the evidence of the sample is sufficient to warrant (a) or (b). Thus, inspection is continued until the cumulated evidence is sufficiently strong, one way or the other, for the inspector to call the lot acceptable or unacceptable. ''Sufficiently strong'' is made determinant by specifying acceptable risks of making incorrect decisions.

By this procedure, conspicuously good lots are quickly accepted, conspicuously bad lots are quickly rejected, and extensive inspection is needed chiefly by lots of doubtful quality, greatly increasing thereby the efficiency, and reducing the cost, of acceptance inspection. Mathematical analysis indicates that sequential analysis may yield a savings frequently greater than 50 per cent.

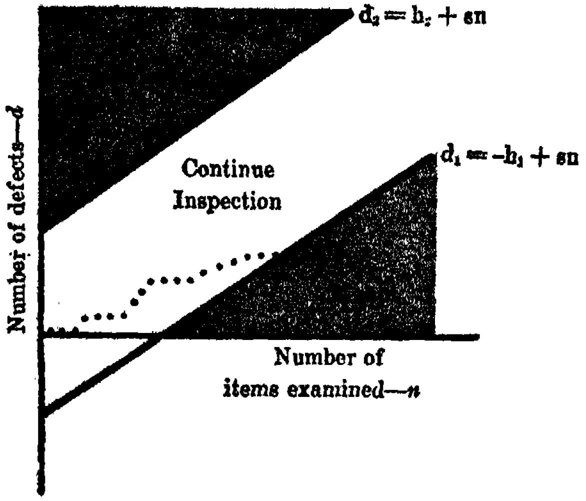
These studies make fascinating reading for those who have not been permitted, because of wartime secrecy, to follow the new developments in sequential analysis that occurred during the War. A beguiling and stimulating procedure has been devised that would seem to guarantee exciting vistas as one contemplates possible applications of great practical importance, such applications already having been extensively made by the various branches of the armed forces. The same procedure, modified to suit the problem, can be applied to reduce the cost of sampling analysis in connection with experimental work, presumably both in agriculture and in industry; and it can be applied to a series of multiple samples as well as to a sequence of observations.

While considerable mathematical patience is required to comprehend rigorous demonstration of the procedure, the intuitive explanation can be grasped by anyone trained in the fundamentals of the modern theory of sampling.

The procedure devised is such that a table can be drawn up; or an acceptance inspection chart, almost identical in form for a variety of problems, can be set up as a standard procedure. This chart is as simple in form and as broad in application as the widely used quality-control chart.

When this chart has been constructed, the procedure consists simply of the sequential plotting against n (number of items examined) of the number of defects observed, d, for which the vertical scale is used. This

Acceptance Inspection Chart



is continued until the plotted line runs either into the area of acceptance or into that of rejection. The dotted line in the figure shows how a set of results would lead, for example, to acceptance.

The equations for the two lines that mark the margins of acceptance and of rejection are derived from the following set of inequalities:

$$\text{B.14} \qquad \frac{p_2^d(1-p_2)^{n-d}}{p_1^d(1-p_1)^{n-d}} \begin{cases} \geqq A & \text{Accept } p = p_2 \\ \leqq B & \text{Accept } p = p_1 \\ < A \text{ and } > B & \text{reserve judgment, take additional observation} \end{cases}$$

By taking logarithms, this becomes

$$\text{B.15} \qquad d \log \frac{p_2}{p_1} - (n-d) \log \frac{1-p_1}{1-p_2} \begin{cases} \geqq a \\ \leqq b \\ < a \text{ and } > -b \end{cases}$$

in which $a = \log A$ and $b = \log B$.

From the first inequality in B.15, the marginal line is obtained by $d_1 = -h_1 + sn$; from the second inequality in B.15, the marginal line is obtained by $d_2 = h_2 + sn$. In these, s, h_1, and h_2 are parameters dependent on p_1, p_2, α and β.

In the inequalities, A and B (for which a and b are the logarithms) are so determined that, if H_1 is true, the probability will be α, or less, that H_2 will be accepted; and so that, if H_2 is true, the probability will be β, or less, that H_1 will be accepted. Thus, whenever H_2 is accepted, $p_2 \geqq Ap_1$ and the total probability of obtaining a sample that will lead to the acceptance of H_2 is at least A times as large when H_2 is true as when

pathfinding texts

hoeber book news

By Nielsen

AGNOSIA, APRAXIA, APHASIA

BRILLIANT exploration of agnosias, apraxias, and aphasias, and the value of these cerebral disturbances in diagnosis. This completely new up-to-date edition considers failures of recognition, communication, and motor coordination from the standpoint of the philosophy of cerebral function on the one hand, and cerebral localization in neurologic diagnosis on the other. J. M. NIELSEN of *U. of South. Cal.* has created a pioneer scientific objective volume. ***Ready soon,*** *302 pp., 59 illus., $5.00*

By Mainland

ANATOMY ("as a living subject . . .")

"CONGRATULATIONS to Donald Mainland of Dalhousie for this revolutionary sensible approach to anatomy," says *Southern Med. Journal.* "The whole book is refreshing, showing all phases of anatomy as subject to wide ranges of normal variation, and integrating these constitutional differences with disease incidence. The very acceptance of the fact that human individuality is made up of hereditary and acquired variations from the mode makes anatomy a living subject." *880 pp., illus., $7.50*

CONVENIENT ORDER BLANK

Sci. 66

PAUL B. HOEBER, INC., ***Publishers***
Medical Book Dept. of HARPER & BROTHERS
49 E. 33rd St., New York 16, N. Y.

Send me: ☐ AGNOSIA ☐ ANATOMY
☐ On Approval ☐ C.O.D. ☐ Check Encl.

Name .... Address ....

H_1 is true. Now α is by definition the probability of accepting H_2 when H_1 is true; and $1-\beta$ is, by definition of β, the probability of accepting H_2 when H_2 is true. Thus, A must be so set that $1-\beta \geqq A\,\alpha$. From this the approximation follows that $A \doteq \frac{1-\beta}{\alpha}$. (An exact analysis of the discontinuities would permit a slightly smaller a; the use of a somewhat too large a has the effect of reducing the risks of error slightly below α and β.) By a similar line of reasoning, $B \doteq \frac{\beta}{1-\alpha}$, so that $a \doteq \log \frac{1-\beta}{\alpha}$ and $b \doteq \log \frac{\beta}{1-\alpha}$.

Tables are provided for obtaining values of a and b for selected values of α and β ranging from .001 to .40 Tables are also provided for finding the values of s, h_1, and h_2; these values can also be found by using the nomographs devised for that purpose. They are determined by the values of α, β, p_1 and p_2, which are fixed for the problem in hand. The acceptable quality limit is p_1; the unacceptable quality limit is p_2; α is the maximum risk or probability of rejecting lots of quality p_1 or better; and β is the maximum risk or probability of accepting lots of quality p_2 or worse.

Three other tools of analysis are supplied in the procedure: the operating characteristic (OC) curve, the average outgoing quality (AOQ) curve, and the average sample number (ASN) curve. The OC curve shows the relationship between the probability of accepting a lot and the true quality (fraction defective) of the lot. For most sampling plans it is unnecessary to construct these curves; but it is important to compute the average sample number for $p = p_1$ and $p = p_2$. Thus, in one of the problems illustrated the authors found $\bar{n}_{p_1} = 63$ and $\bar{n}_{p_2} = 61$. It could be assumed from these values that on the average the decision to accept or reject would be reached by the time 61–63 observations had been made. In the problem illustrated the decision was reached at the fifty-third observation. Being able to tell in advance approximately how large a sequential number of observations will be required to reach a decision is certainly an important advantage of the method.

Criticism is rampant on the question of acceptance sampling, but for the most part it deals with the validity of the tests, the relationship of the test to expected performance, the randomness of the samples, etc. However fine a method of analysis may be, it will remain impractical unless the data analyzed are suitable and in conformance with the assumptions involved in the method. Nevertheless, that criticism cannot detract from the importance of the contribution made by those who have developed the method of sequential analysis. The method is neatly and ingeniously contrived, and it is surprisingly simple in application as far as the primary requirements of any particular problem are concerned.

JAMES G. SMITH

Princeton University

War on Weeds

(*Continued from p. 468.*)

References

1. BALL, W. E., and FRENCH, O. C. *Calif. agric. exp. Sta. Bull. 596*, 1935, 1–29.
2. BLACKMAN, G. E. *Nature, Lond.*, 1945, **155**, 500–501; NUTMAN, P. S., THORNTON, H. G., and QUASTEL, J. H. *Nature, Lond.*, 1945, **155**, 498–500; SLADE, R. E., TEMPLETON, W. G., and SEXTON, W. A. *Nature, Lond.*, 1945, **155**, 497–498.
3. BOLLEY, H. L. *N. D. agric. exp. Sta. Ann. Rep.*, 1901, **11**, 48–50; *N. D. agric. exp. Sta. Bull. 80*, 1908, 541–574.
4. BONDE, R., and SCHULTZ, E. S. *Me. agric. exp. Sta. Bull. 438*, 1945, 535.
5. CRAFTS, A. S. *Science*, 1945, **101**, 417–418.
6. CRAFTS, A. S., and REIBER, H. G. *Calif. agric. Coll. Mimeo.*, April 1944; RAYNOR, R. N. *Calif. agric. Coll. Mimeo.*, March 1944; CRAFTS, A. S., and RAYNOR, R. N. *West. Grower Shipper*, 19 August 1944; HARVEY, W. A. *Calif. agric. Coll. Mimeo.*, November 1945.
7. GOWANDLOCH, J. N. *La. Conservationist*, 1944, 2, 3, 6, 8.
8. GRIGSBY, B. H., and BARRONS, K. C. *Mich. agric. exp. Sta. Quart. Bull. 27*, 1945, 3; GRIGSBY, B. H. *Mich. agric. exp. Sta. Quart. Bull. 28*, 1946, 3.
9. HAMNER, C. L., and TUKEY, H. B. *Science*, 1944, **100**, 154–155.
10. HELGESON, E. A., and GEBRACHT, D. *N. D. agric. exp. Sta. Bimonth. Bull.*, 1940, **3**, 7–10.
11. HILDEBRAND, E. M., and PALMITER, D. H. *Proc. N. Y. hort. Soc.*, 1942, **87**, 34–40.
12. HIRSCH, A. A. *Bot. Gaz.*, 1942, **103**, 620–621.
13. LACHMAN, W. H. *Proc. Amer. Soc. hort. Sci.*, 1944, **45**, 445–448; *Mass. St. Coll. Spec. Circ. 120*, April 1945.
14. LITZENBERGER, S. C., and POST, A. H. *Mont. agric. exp. Sta. Bull. 411*, 1943.
15. LITZENBERGER, S. C., POST, A. H., and BINGHAM, G. H. *Mont. agric. exp. Sta. Bull. 430*, 1945, 1–17.
16. LOOMIS, W. E., and NOECKER, N. L. *Science*, 1936, **83**, 63–64.
17. MITCHELL, J. W., and HAMNER, C. L. *Bot. Gaz.*, 1944, **105**, 474–483.
18. MUENSCHER, W. C. *Weeds.* New York: Macmillan, 1935.
19. NEWHALL, A. G., LAWRENCE, G. H. M., and JUSTICE, O. L. *Cornell Univ. agric. exp. Sta. Bull. 784*, 1942, 1–27.
20. RABATE, E. *J. agric. Prat.*, 1911, **75**, 407–409.
21. ROBBINS, W. W., CRAFTS, A. S., and RAYNOR, R. N. *Weed control.* New York: McGraw-Hill, 1942.
22. SCHWENDIMAN, A., TORRIE, J. H., and BRIGGS, G. M. *J. agric. Soc. Agron.*, 1943, **35**, 901–908.
23. SWEET, R. D., KUNKEL, R., and RALEIGH, G. J. *Proc. Amer. Soc. hort. Sci.*, 1944, **45**, 440–444.
24. SWEET, R. D., RALEIGH, G. J., and KUNKEL, R. *N. Y. St. Coll. Agric. Mimeo. Bull. V–33*, April 1945.
25. TAYLOR, F. J. *Country Gent.*, February 1942.
26. WARREN, G. F. *Univ. Wis. Mimeo.*, December 1945.
27. WESTGATE, W. A., and RAYNOR, R. N. *Calif. agric. exp. Sta. Bull. 634*, 1940, 1–36.
28. WRIGHT, F. B. *N. Y. St. agric. exp. Sta. Mimeo. 318*, 1945, 1–11.
29. YOUNG, P. A. *J. agric. Res.*, 1935, **51**, 925–934.
30. ZIMMERMAN, P. W., and HITCHCOCK, A. E. *Contr. Boyce Thompson Inst.*, 1942, **12**, 321–344.
31. ————. *Miss. St. agric. exp. Sta. Circ. 118*, 1945; *Agric. Eng.* 1945, **26**, 147–148.
32. ————. Selective weed control. *Nat. News Views* (Winnipeg, Manitoba) June 1944.
33. ————. *Timely Turf Top.*, November 1944; HAMNER, C. L., and TUKEY, H. B. *Bot. Gaz.*, 1944, **106**, 232–245; MARTH, P. C., and MITCHELL, J. W. *Bot. Gaz.*, 1944, **106**, 224–232; MITCHELL, J. W., DAVIS, F. F., and MARTH, P. C. *Turfdom*, October 1944; ZIMMERMAN, P. W., HITCHCOCK, A. E., and HARVILL, E. K. *Contr. Boyce Thompson Inst.*, 1944, **13**, 273–280.
34. ————. *U. S. Dept. Agric., B.P.I.–S–A.E. Mimeo.*, July 1945, 1–4; BUCKHOLTZ, K. P. *Univ. Wis. Mimeo.*, December 1945; CHAPMAN, I. D. *La. Conservationist*, 1945, **3**, 7; GRIGSBY, B. H., and HAMNER, C. L. *Mich. agric. exp. Sta. Ext. Fold. 88*, January 1946, 1–4; JOHNSON, E. *Calif. Citrograph*, 1945, **30**, 305; MARTH, P. C., DAVIS, F. F., and MITCHELL, J. W. *Bot. Gaz.*, 1945, **107**, 129–136; MARTH, P. C., and DAVIS, F. F. *Bot. Gaz.*, 1945, **106**, 463–472; MITCHELL, J. W., and BROWN, J. W. *Bot. Gaz.*, 1945, **107**, 120–128; MITCHELL, J. W., and MARTH, P. C. *Bot. Gaz.*, 1945, **107**, 276–284; TUKEY, H. B., HAMNER, C. L., and IMHOFE, B. *Bot. Gaz.*, 1945, **107**, 62–73; VAN OVERBEEK, C. J. *Science*, 1945, **102**, 621; WILLARD, C. J. *O. St. Univ. Mimeo.*, January 1946.

SCIENCE

Vol. 103, No. 2678 Friday, April 26, 1946

The Little Researcher

Carl G. Hartman

Retiring Vice-president, Section F, AAAS, and Professor of Zoology, University of Illinois

IT HAS BEEN RIGHTLY SAID that war does not favor the discovery of new principles in science, although, superficially, we seem to make progress through the exigencies of war at greatly accelerated speed. But science in wartime is largely technology. Gadgets are refined to almost unbelievable delicacy.

Many people do not seem to understand this basic fact. The Bush Committee's slogan, "Back to Basic Research," was emphasized for physics and chemistry, but did not extend to biology; for the report did not recognize that medicine and agriculture are applied or "technological" sciences. The men who wrote the report failed to grasp the fact that medicine and agriculture would languish if basic biology dried up, just as engineering applications would cease to prosper if pure research in physics and chemistry were stifled. In the compromise Kilgore-Magnuson Bill (S. 1850), we as biologists are glad to note that the biological sciences are recognized—at least on paper—on a par with the physical sciences.

When we view our national pre-eminence in the fields of applied science, *i.e.* in technology and "Yankee inventiveness," we should not forget that until recently we have been borrowers from Europe, and particularly from Germany, of the basic principles upon which our most cherished gadgets, the automobile, the airplane, and the radio, depend. With a large part of Europe suffering a severe setback in research, we must take over; otherwise, applied research, which provides better and more useful things—and also jobs—will gradually dry up.

Our Government is wise, therefore, in taking steps to stimulate both pure and applied research. America must organize its scientific talent into as effective a machine as possible. Congress is struggling with this problem. Many are concerned, however, lest the "control" of research be centered in an irresponsible governing board which will administer the law in a spirit of authoritarianism. Without freedom of thought, initiative and originality will be stifled. No group of men is endowed with omniscience, or the clairvoyant gift of knowing in which direction science will sometime advance; indeed, while scientists may plan an attack on a problem through a series of experiments and observations, the results may lead them into unexpected and unforeseen highways. Even the wise manager of industrial research will give a maximum of freedom consistent with the objectives of a given laboratory, which are necessarily more of a short-range order. But there should be no difference in the basic training for either pure or applied research; for if one accepts a place on a team, it is his duty to help carry the ball to the common goal.

The chief function of the Federal Research Board—the "National Science Foundation" of the new Kilgore-Magnuson Bill—will be the placing of financial support where the prospect of returns seems most certain. This is a great responsibility; How it will be met is the concern of all the people. I have a very modest suggestion involving only 1 or 2 per cent of the hundred million dollars recommended for the annual budget of the Foundation. It is my recommendation that 1 or, at most, 2 per cent be apportioned to the Little Researchers, of whom there are thousands, chiefly instructors of science in the small colleges. Just as it is agreed that the Little Business Man is a powerful factor in our economic life, I hold that the Little Researcher constitutes a not inconsiderable factor in the development of scientific research in the United States, as elsewhere. I speak chiefly from the viewpoint of the biologist, but am of the opinion that what I say is also true of the physical sciences and the social sciences.

Colleges and universities are the training schools of researchers and are the source of the available research personnel. They are the home of research and, although much research has been transplanted to industry and to endowed research institutes, these must always look to the universities for their trained investigators and their research directors.

It is hard to realize how recent these developments

Address delivered at St. Louis, 29 March 1946, before the American Society of Zoologists and Section F, AAAS.

are! As Dr. Harlow Shapley said in his testimony at the U. S. Senate hearings on the Kilgore Bill: "It's been only a few years that we were in a position to say to our scientists, 'At least half of your time and responsibility are to be devoted to original investigation in your field of science.'" The Johns Hopkins University, founded in the 1880's, was the first university in the United States to be organized on the German plan, which provided for teaching and research as dual functions of all of the members of the faculties.

The transfer of research to large industrial corporations is a still more recent development, for at the beginning of this century there were exactly three "industrial" scientists; this clan now numbers 70,000.

The universities which took the lead in providing opportunities for research and teaching were at first the richest and strongest. Today the number of colleges and universities runs into the thousands. Dr. R. Walters, in *School and Society,* 6 December 1939, lists about 100 "large" and 400 small universities and colleges. These are the "upper 500" in the college field. In the first group of Walters' classification 700,000 students are taught by 50,000 teachers. In the 400 smaller four-year Colleges of Liberal Arts and Sciences listed by Walters, 240,000 students are taught by 22,000 teachers. These professors, together with 8,500 teachers in technological schools and 5,000 in teachers' colleges, constitute quite an array—over 75,000—of potentially qualified researchers.

In addition to the schools mentioned, there are a thousand weaker institutions of "higher learning" which serve as best they can in the neighborhood of another 25,000 young people.

What is the status of research in these colleges? Certainly the larger universities—Walters' first 100, let us say—possessing the pick of the personnel and almost limitless equipment, will, except for isolated cases, lead in research output. An examination of abstracts of papers published in the *Proceedings of the American Society of Zoologists* shows that teachers in the larger universities write most of these. The same holds for the American Botanical Society. This may be due in part to the fact that the small-college teacher does not attend national meetings.

In proceedings of state and local academies of science the small-college teacher makes a somewhat better showing. About one-third of the articles come from the many small colleges and high schools of the state, while the three large universities, Chicago, Illinois, and Northwestern, contribute 42.7 per cent, and professional schools, 10 per cent.

If research has been an essential and axiomatic function of large universities for less than a century and of industry for half that period, why not interpret this movement as a trend that will presently extend to the smaller colleges, which we are now prone to think of merely as teaching institutions?

A prime hindrance to research is the heavy teaching schedule usually imposed upon the teacher in the small college. In some instances only a superman could carry the load and, in addition, even think of research problems. Paradoxically, it is these selfsame institutions that pride themselves on their pedagogics, claiming superiority over big universities because of "personal attention" to the student. Personally I would rather send my son or daughter to a university where a class of 500 is divided for laboratory and quiz purposes into sections of 20 to 24 students conducted by enthusiastic instructors who know their subject thoroughly—a condition which a live department seeks to maintain—than to a small institution where the overworked instructor has to hop with superficial preparation from one subject to another all day long and sometimes at night. Such a condition is, of course, an extreme but all too common one.

SOURCES OF ILLINOIS STATE ACADEMY CONTRIBUTIONS*
1935–1944

Year	Small colleges and high schools	Large universities	State surveys, museums, and gov't bureaus	Professional or nonacademic	Total
1944	4	11	3	4	22
1943	16	17	11	6	50
1942	33	43	9	4	89
1941	27	52	5	9	93
1940	28	41	11	4	84
1939	23	42	15	11	91
1938	21	30	12	8	71
1937	48	29	11	7	95
1936	25	25	18	12	80
1935	29	40	19	9	97
	254	330	114	74	772

* Acknowledgment is made to Miss Dorothy Rose, editor for the Illinois State Academy of Science, for this tabulation.

Often the inability of the biology professor to distinguish genuine learning from superficiality is shown in the way the teacher stuffs his catalogue with courses. I have before me the catalogue of a college of 200 students whose Biology Department is manned by one man who presides over 33 courses, 6 of which are given at night! I know of a teacher who had a vacant period which he used to work with his small rat colony. When the president found this out, he assigned him a class at his "vacant" period, while the teachers who loafed or rested in their vacant periods continued to loaf or rest.

Such conditions are usually the fault of the college president. "Let the big centers of learning attend to the research," he is apt to say; "we have the world's teaching on our shoulders."

That this attitude is inimical to the best interests of his college I shall attempt to prove by showing that research makes for (1) perpetual youthful enthusiasm on the part of the college teacher for his subject and its dissemination, which enthusiasm is (2) "catching" to the student and (3) worth while in itself.

The first two arguments for research on the part of the college teacher are closely related, for the saying, "As teacher, so pupil," is as true today as it was yesterday. The argument that a person is a good teacher because he takes no interest in research is most inane, although it is likewise foolish to claim that a successful researcher is always a good teacher. An astoundingly large proportion of graduate students come from certain small colleges through the personal influence of certain professors. Such professors may not always publish extensively, but they, with their students, are continuously reconnoitering along the frontiers of learning.

The extent to which the small college contributes students to the graduate schools of the larger universities is indicated in these figures: Among the 12,000 college graduates who took the Graduate Record Examination the first five years (these were given in the years 1937–1942) 500 colleges were represented. It would be interesting to analyze these data. It is high time that the contribution of the small college in awakening our future science personnel be more fully recognized.

In his clever but, through overstatement, misleading book, *Teachers in America,* Jacques Barzun contends (p. 202) that, where there is emphasis on research, "parents and students must be reconciled to indifferent teaching as the rule, and men choosing the academic career must either give up hope of advancement or be master-jugglers in their early years, at the cost of other good things of life—health, friendship, and contemplation."

But let us be reasonable. Everything may be abused, and in places there may be undue emphasis on research. Cases of neglect of students by the Big Researcher are well known to all of us. Nevertheless, I do hold, and have seen it happen, that "the man who ceases studying at 25 is a dried-out and dull teacher 10 years later." It is unfortunate that just such driftwood all too often gravitates to elementary instruction, to the great detriment of the student as well as the subject. On the other hand, one of my friends, a very productive researcher, who recently left a research institute to join a small college, writes me that he is happy to be back at teaching and especially happy that at the end of his first year a half dozen students upset tradition by doing research with him. The new idea is the talk of the campus.

Research may also be used in elementary courses, as, for example, in the project method described in the October 1926 *Anatomical Record* by Dr. Madeleine Grant, of Sarah Lawrence College, or the "optional experiment" which my colleagues, Steggerda and Gray, described in the February 1940 *Journal of Higher Education* and which they have used with considerable success in an elementary, five-semester-hour course in mammalian physiology.

The intellectual awakening which the college student experiences in the favorable environment has great social value. It devolves on the small colleges, partly because of their number and strategic position of nearness to the people, to help recruit scientists. Because of the war there is a deficit of 150,000 students of science and technology who would have received the Bachelor's degree. It has been estimated by the Bush committee that by 1955 the deficit of those holding advanced degrees will be about 17,000. One of the objectives President Roosevelt had in mind in instructing the Bush committee to study the science situation in America concerned the discovery of scientific talent. He used the following language: "Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?" With one accord we all say: "Of course it can."

When I was in Russia in 1935, attending the International Physiological Congress, I found the enthusiasm among the young scientists perfectly electric. We can do the same, for we have a good start.

I fully realize that research has some of the attributes of the creative and requires what has been called the scientific imagination. The urge must come from within. Perhaps there are industrious teachers of science wholly lacking in this who yet can hardly be said to have missed their calling. I cannot help believing, however, that anyone reading "critically and voluminously" (presumably as a substitute for research?), as Barzun suggests, wil sooner or later become aware of the fragmentary nature of his knowledge and experience a curiosity about methods of finding out things he does not know.

We do not expect to find geniuses everywhere in science departments of either the large universities or the small colleges. Very rarely architects of the framework of science, like Faraday or Pasteur or Darwin, appear either in a large or a small university. But there would be no architects if the day laborers of science were not adding stone on stone and sand-grain on sand-grain to the building. For no generalization was ever grasped out of thin air, but was based on the multitude of facts laboriously collected and recorded in print by the "hod carriers" of science.

Even a small study may have, to the researcher, broader implications than appear on the surface. I recall my *first publication*. My chief, the late Dr. T. H. Montgomery, was writing a monograph on a genus of spiders and had to find out if the number of teeth on the claws of spiders was a reliable specific character. The result was my paper on "Variability of the number of teeth on the claws of adult spiders"—on the surface, about as unimaginative a piece of work as possible. Yet it put me in touch with the universal principle of variation, the raw material of evolution; I learned something of taxonomy; and I got interested in spiders—all this by working concretely on a small problem. Certainly nobody reading the paper would derive any inspiration therefrom; but it did settle one small point for Dr. Montgomery, and that infinitesimal part of the world's work was done. We should not criticize any piece of research because it is small but only because it is not well done, if that is the case.

I hope I have made out a case for the Little Researchers—the science teachers in the small colleges constitute an army of actual and potential researchers. In this I seem to have the support of the Bush committee, which says, speaking of the small-college, "nonresearch institutions":

> In developing a program of postwar federal aid to scientific research, attention should be given to the potentialities of these schools. To the extent that one sample is representative, at least 40 per cent of the small liberal arts colleges in this country are desirous of conducting research, and are prevented from doing so by lack of funds.

I therefore ask for the Little Researcher a small part of the sum about to be appropriated by Congress for the stimulation of research. I would ask for only 1 per cent of the annual appropriation contemplated in the Bush report. One per cent sounds like a modest proportion, but it is in fact a huge sum compared with past and present sums available. In this connection I am reminded of the fund which the Illinois Academy of Science has had to dispense for research, a sum which by common consent went annually to men in the smaller colleges. In 1943, when I served as chairman of the committee, we had the munificent sum of $213.37 to dispense! This was divided among three men and was much appreciated far beyond the amount of money involved.

By way of contrast, research now runs into big money. The troublesome 200-inch reflector for the Mt. Palomar Observatory will cost considerably over $1,000,000; Dr. Lawrence's cyclotron at the University of California has cost about the same; the Illinois legislature has appropriated out of state funds the sum of $1,700,000 for the University's "betatron," the electron accelerator; the expenditures of the Yerkes Laboratories of Primate Biology, devoted to researches on the chimpanzee, are approaching the $750,000 mark. It is apparent to anyone who looks into the matter that the bulk of moneys must be concentrated for big things in the big laboratories. Broadly conceived, long-time programs are no longer one-man jobs, but require teams and cooperation, in attacks even upon single problems, of scientists possessing information in a variety of fields. Basic biological researches require more and more the collaboration of the physicist and the chemist with the biologist. Many researches now require expensive equipment beyond the imagination of scientists of 50 years ago.

I therefore agree heartily that the bulk of public funds for research must go to the large centers. At the same time I do contend that a small part of the new financial aid should trickle down to the Little Researchers scattered widely over the country. I predict that the results of aid to these one-man organizations will amply justify the outlay.

Scanning Science—

The professor of mineralogy in Harvard University one day observed two young women examining his mineral cabinet, one of whom was evidently searching for some particular species. Offering his help, he found that the object of her quest was feldspar. When shown the mineral she seemed very much interested in the specimens, expressing herself as gratified at having the chance to see and touch them. The professor asked her why she so desired to see the particular mineral. The answer was that for some years she had been obliged to teach in a neighboring high school, among other things, mineralogy and geology, and that the word feldspar occurred so often in the text-book that her curiosity had become aroused as to its appearance.

—24 April 1896

Technical Papers

Distemperoid Virus Interference in Canine Distemper[1]

ROBERT G. GREEN and CYRIL S. STULBERG
Department of Bacteriology and Immunology
University of Minnesota Medical School, Minneapolis

Serial passage of the canine distemper virus through ferrets has been shown by Green (*6*) to reduce its virulence for foxes and dogs so that it produces a mild immunizing distemperoid infection when injected into these animals. In 1938, when the distemperoid virus was first used to eliminate distemper from the large Fromm herds of silver foxes (*7*), it was noted that numerous fox pups exposed to fatal infections apparently were cured in the early stages of the infection. Veterinarians trying out the new distemper vaccine in dogs sometimes injected it first into mongrels sick with distemper and observed that the vaccine, instead of exaggerating the infection, seemed to assist in recovery of the dogs. Stader and Slaughenhaupt (*15*), in studying the immunizing effect of distemperoid virus vaccine in dogs, observed that upon injecting the vaccine there was an immediate protection against distemper and referred it to a "cell-block" effect. Schlotthauer (*14*) reported that dogs injected with 15 mg. of distemperoid virus did not contract distemper upon exposure immediately after inoculation, but that dogs injected with smaller doses, such as 7.5 and 2.5 mg., did so.

The interference phenomenon in animals was first observed, independently, by Hoskins (*9*) and by Magrassi (*12*) in 1935. Magrassi reported an interference between nonencephalitic and encephalitic herpes viruses in rabbits, while Hoskins demonstrated interference between neurotropic and pantropic yellow-fever viruses in monkeys. Findlay and MacCallum (*5*) confirmed and extended the work of Hoskins and were able to show that the Rift Valley fever virus protected monkeys against pantropic yellow-fever virus, while the neurotropic strain of yellow-fever virus protected mice against the Rift Valley fever virus. That the virus of lymphocytic choriomeningitis protected monkeys against a virulent monkey strain of poliomyelitis virus was demonstrated by Dalldorf (*3*). Jungeblut and Sanders (*11*) showed that the virus of murine poliomyelitis, also, protected monkeys against virulent monkey strains of poliomyelitis virus, and recently Jungeblut (*10*) has made extensive studies of the factors governing the phenomenon.

Andrewes (*1, 2*) noticed an interference between virus III and the virus of Shope fibroma in rabbits and later used tissue cultures to demonstrate that a strain of influenza A virus interfered with the growth of a neurotropic variant of that virus. Subsequently it was shown by the Henles (*8*) and by Ziegler, Lavin, and Horsfall (*16*) that interference occurs between the viruses of influenza A and influenza B, between these and swine influenza virus, and between inactivated and active influenza viruses; the antagonistic effects of these viruses on one another were observed in embryonated eggs. The interference phenomenon between bacterial viruses has been studied extensively by Delbruck and Luria (*4*), while studies made by workers on similar phenomena between plant viruses have been reviewed by Price (*13*).

We have now obtained experimental data to establish that the ferret-passage virus will, upon intramuscular inoculation, interfere with the course of a distemper infection established by nasal inoculation with a highly virulent distemper virus. In one of our experiments, 40 red fox pups were divided into groups of 10 and each group was inoculated as follows: Group A, as a control group, received virulent distemper virus only. Group B was inoculated with virulent distemper virus and distemperoid virus simultaneously. Group C received virulent distemper virus first and distemperoid virus 3 days later. Group D received virulent distemper virus first and distemperoid virus 12 days later.

The virulent distemper virus was prepared for inoculation from frozen, infected fox spleens. The ground tissue was diluted to 25 per cent in Ringer's solution, and each fox was inoculated intranasally with 0.4 cc. (100 mg.). The distemperoid virus was ferret-passage virus of the sixty-third generation in ferrets, frozen as 25-per cent homogenized ferret spleen in horse serum. In all cases, 200 mg. was inoculated intramuscularly into the legs of the designated foxes. The animals were observed daily for symptoms of distemper. A necropsy was performed on animals that died from the infection, and smears were made of the epithelial cells lining the bladder and the trachea. In every dead animal typical cytoplasmic inclusions characteristic of distemper were seen. Results observed for the different groups of animals are as follows:

Group A. On the sixteenth day following the inoculations of virulent distemper virus, all animals in

---

[1] Aided by a grant from the Graduate Medical Research Fund of the University of Minnesota and by experimental facilities and financial support furnished by Fromm Laboratories, Inc., Grafton, Wisconsin.

the control group exhibited marked symptoms of distemper. The first death occurred on the twenty-fifth day, and at the end of 36 days all the animals in this group had died of typical distemper.

Group B. In this group, which was inoculated simultaneously with virulent distemper virus and distemperoid virus, 2 foxes showed symptoms on the sixteenth day. By the twenty-third day, 5 animals showed some symptoms of distemper. However, they recovered promptly, and by the thirty-first day all appeared well.

Group C. In the group receiving distemperoid virus 3 days after the inoculation of virulent distemper virus, only 2 foxes showed symptoms. These became sick on the twenty-third day and were normal again on the thirty-first day.

Group D. One of the animals receiving the distemperoid virus 12 days after the virulent distemper virus showed symptoms on the nineteenth day, and 4 of this group showed symptoms by the twenty-third day; all had recovered by the thirty-second day.

The decisive results obtained in this study are further accentuated by the fact that foxes seldom recover from distemper once they have exhibited any symptoms whatsoever. In this case, the distemper virus used was a fox-passage virus of high virulence for that animal. From the results, it seems definitely established that there is a marked antagonistic effect of the distemperoid virus on a virulent distemper infection, and this effect appears sufficiently significant to be utilized practically in the treatment of distemper. In fact, in this experiment the antagonistic effect of the distemperoid vaccine was just as great when the ferret-passage virus was used 12 days after inoculation of virulent virus as when it was used within an hour after such inoculation; and in both cases the distemperoid vaccine prevented any fatalities. Our results corroborate our earlier clinical observations on foxes and those of Stader and Slaughenhaupt on dogs, as well as the experimental observations of Schlotthauer. In addition, a definite therapeutic effect of the modified virus on the virulent infection seems demonstrated for the incubation period and early stage of the infection. Thus, it appears that a modified virus may be useful for both the prevention and the therapeutic treatment of a disease caused by a virulent strain of the same virus.

SUMMARY

A distemper virus modified by ferret passage so as to become a harmless vaccine for foxes and dogs exhibits the interference or cell-blockade phenomenon with respect to a virulent distemper infection in foxes. Ten control foxes receiving virulent distemper virus died, while 30 foxes receiving distemperoid virus in addition lived.

References

1. ANDREWES, C. H. *J. Path. Bact.*, 1940, **50**, 227.
2. ANDREWES, C. H. *Brit. J. exp. Path.*, 1942, **23**, 214.
3. DALLDORF, G. *J. Immunol.*, 1939, **37**, 245.
4. DELBRUCK, M., and LURIA, S. E. *Arch. Biochem.*, 1942, **1**, 111.
5. FINDLAY, G. M., and MACCALLUM, F. O. *J. Path. Bact.*, 1937, **44**, 405.
6. GREEN, R. G. *Amer. J. Hyg.*, 1945, **41**, 7.
7. GREEN, R. G., and CARLSON, W. E. *J. Amer. vet. med. Ass.*, in press.
8. HENLE, W., and HENLE, G. *Amer. J. med. Sci.*, 1944, **207**, 705.
9. HOSKINS, M. *Amer. J. trop. Med.*, 1935, **15**, 675.
10. JUNGEBLUT, C. W. *J. exp. Med.*, 1945, **81**, 275.
11. JUNGEBLUT, C. W., and SANDERS, M. *J. exp. Med.*, 1942, **76**, 127.
12. MAGRASSI, F. *Z. Hyg. Infektionskr.*, 1935, **117**, 501, 573.
13. PRICE, W. C. *Quart. Rev. Biol.*, 1940, **15**, 338.
14. SCHLOTTHAUER, C. F. *J. Amer. vet. med. Ass.*, 1943, **103**, 290.
15. STADER, O., and SLAUGHENHAUPT, R. R. *N. Amer. Veterinarian*, 1942, **23**, 782.
16. ZIEGLER, J. E., JR., LAVIN, G. I., and HORSFALL, F. L. *J. exp. Med.*, 1944, **79**, 379.

Availability of Carotene From Kale

ELSA ORENT-KEILES, ELIZABETH CROFTS CALLISON,
JEANETTE SCHAEVITZ, and RUTH FRENCHMAN

Bureau of Human Nutrition and Home Economics
USDA, Washington, D. C.

Measurement of the vitamin A value of vegetables presents considerable difficulty. Figures quite disproportionate to known biological values have been reported by various investigators for the chemical determination of the carotene content of certain vegetables. Different vegetables of equal carotene content have been found to vary in their vitamin A value as determined by biological assay. This fact has led to the assumption that when carotene is ingested in the form of vegetable foods, it is less effective than when taken in pure form. It has, at times, been suggested that the discrepancies may be explained by the known inaccuracies of the biological estimations, coupled with the problem of obtaining representative samples. However, it is unlikely that the errors of all workers in this field should be consistently in the same direction. Therefore, the true relationship between the carotene content of vegetables as measured by chemical analysis and bio-assay is of fundamental importance.

As a part of an investigation on the factors influencing the utilization of carotene from vegetable foods, experiments were devised for the study of kale to determine whether or not digestibility of the vegetable tissue is one of the factors causing these differences. These experiments were designed so that chemical chromatographic analyses for carotene were made of the kale parallel with bio-assays on both the kale itself and an extract of the carotenoids from the vegetable.

Sixty-four chemical analyses were made, and 138 rats were used in the biological assays. Eighteen different lots of kale, purchased on the Washington market, have been used in this study, one bushel being obtained for analysis weekly. Since kale is commonly eaten by human beings in the cooked form, the analyses were made on cooked kale. In addition, cooking the kale served to inactivate the enzymes destructive of carotene, thus eliminating one factor that is impossible to control in bio-assays. The kale was thoroughly washed with distilled water and steam cooked. It was then spread on trays, cooled, and a representative sample of appropriate size withdrawn. The leaves were stripped along the midrib so that none of either the midrib or petiole was included. One-half of each leaf blade was removed for the biological assays, and the corresponding half was used in preparing the extract which was analyzed biologically and chemically. The chlorophylls and xanthophylls were removed by saponification with potassium hydroxide, leaving the carotenoid pigments in the solution. Aliquots were taken from the extract for chromatographing and determining β-carotene spectrophotometrically; the remaining extract was concentrated in cottonseed oil containing hydroquinone and was analyzed biologically.

The measurement of β-carotene was accomplished by a procedure devised in our laboratories based on the methods of Moore and Ely (*1*), using acetone, absolute methanol, and Skellysolve F as extractants and magnesium oxide and magnesium carbonate (1:9) as adsorbents.

The biological assays were performed essentially according to the *U. S. Pharmacopoeia* (11th ed.) method using as the standard of reference pure β-carotene in cottonseed oil prepared in our laboratories.

The data shown in Table 1 represent the average vitamin A values of cooked kale as determined on the vegetable itself and on an extract of the kale.

TABLE 1

Description of sample	Chemical assay*	Bio-assay
	IU/gram	IU/gram
Kale, cooked	90	60
Extract of cooked kale	90	84

* Determined as carotene and converted to vitamin A value, using 0.6 μg. carotene as equivalent to 1 international unit.

From these figures it appears that the vitamin A value of kale as determined by bio-assay is about two-thirds of the value measured spectrophotometrically after chromatographing. On the other hand, when the carotenoid pigments are completely extracted from kale and this extract is used as the vitamin A supplement instead of kale itself, the bio-assay gives a vitamin A value of only 6 per cent less than that obtained by the chemical method. This is well within the experimental error of the bio-assay method and near the upper range of error of the chemical method. This evidence suggests that incomplete digestion of the kale, and therefore incomplete absorption of the vegetable carotene in the intestinal tract of the animal, may be an important factor causing the difference between the vitamin A values of kale obtained by chemical and biological methods.

Reference

1. Moore, L. A., and Ely, R. *Ind. eng. Chem.*, 1941, **12**, 600; 1942, **13**, 726.

The Growth and Distribution of Murine Encephalomyelitis Virus in the Developing Chick Embryo[1]

John T. Riordan and M. José Sá-Fleitas[2]
Section of Preventive Medicine, Yale University School of Medicine

Gard (*2*) has reported the transfer of Theiler's (*5*) FA "mouse poliomyelitis" virus to the developing chick embryo and propagation through four passages. Using the chorioallantoic technique, Gard demonstrated the presence of virus only in the central nervous system (CNS) of embryos which had been inoculated at the age of five, six, and seven days. In eggs inoculated at eight days of age, no virus was recovered from any site. In no instance was virus discovered in membranes or in the corpus minus the brain and vertebral column. Also, CNS harvested 10 days after inoculation was infective for mice inoculated intracerebrally, but CNS harvested 5 days after inoculation was noninfective when tested in the same manner. In Gard's experiments, all eggs were incubated at 37° C. before, as well as after, inoculation. The inoculum consisted of 0.05 ml. of bacteriologically sterile 10-per cent suspension of infected mouse brain. Gard also was successful in transferring the UFI strain of "mouse poliomyelitis" to eggs.

Jungeblut and Sanders (*3*) reported the successful propagation of a murine neurotropic virus in embryonic mouse brain and embryonic guinea pig brain cultures. Using similar tissue cultures, Parker and Hollender (*4*) also were recently successful in propagating the GD VII strain of Theiler's virus through 20 passages.

In the present work the FA strain of Theiler's

---

[1] Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

[2] Alfredo Hirsch Foundation Fellow of the National Academy of Medicine, Buenos Aires, Argentina.

mouse encephalomyelitis virus has been grown in fertile eggs and carried through nine generations.

The original FA stock virus was received in this laboratory from Dr. Max Theiler, in the form of glycerinated mouse brain, in 1941. The material used in this experiment was put through two passages in mice in our laboratory and kept frozen at −70° C. in the form of 20-per cent suspension of mouse brain. Sterile distilled water was used as diluent. This strain is nonpathogenic for monkeys but produces the usual signs of encephalomyelitis when inoculated intracerebrally in albino Swiss mice and cotton rats. A titration of mouse brain in the third New Haven passage yielded an ID$_{50}$[3] titer of $10^{-6.5}$ and an incubation period of 3 to 26 days.

Six-day-old fertile eggs were used, usually from Black Australorps and Rhode Island Reds. Incubation was carried out at 35°–35.5° C. before, as well as after, inoculation. A blower fan type of incubator equipped with a humidifier was used, and a reading of 85°–87° humidity was maintained. The eggs were turned five times daily, before inoculation.

An artificial air space was produced over the embryo, using the method described by Burnet and Faris (*1*). The original inoculum was prepared by grinding infected mouse brain with sterile alundum in cold, sterile distilled water sufficient to make a 10-per cent suspension. This suspension was centrifuged at 2,000 r.p.m. for 10 minutes and the supernate decanted. One-tenth milliliter of this supernate was placed on the dropped chorioallantoic membrane, using a 1-ml. tuberculin syringe and a 25-gauge needle. The opening in the shell over the embryo was then sealed with scotch tape and the small hole over the natural air sac was sealed with nail polish.

In the first three passages, four to six eggs were harvested at both 5 and 10 days after inoculation. Harvests consisted of allantoic fluid, amniotic fluid, chorioallantoic membrane, chick embryo brain, and the corpus minus the CNS. The embryo and chorioallantoic membrane were washed in three changes of cold, sterile saline. The embryo was decapitated, and the vertebral column was excised and discarded. Ten-per cent suspensions of tissues and membrane were made by grinding with sterile alundum in cold, sterile distilled water. These suspensions and the allantoic and amniotic fluids were centrifuged at 2,000 r.p.m. for 10 minutes and 0.03 ml. of the supernatant fluids were tested by intracerebral inoculation in four- to five-week-old Swiss mice. All test animals were observed daily during a period of four weeks. For passage to other eggs, 0.1 ml. of a 10-per cent suspension of chick embryo brain, harvested 10 days after inoculation, was used.

Materials harvested at both 5 and 10 days after inoculation, when tested intracerebrally in mice, showed the virus to be distributed somewhat irregularly throughout the egg. Also in our hands, the distribution differed from the results reported by Gard (see Table 1). The greatest concentration of virus in the egg, as judged by the incubation period and morbidity incidence in inoculated mice, appeared to be present in the corpus minus the CNS after an incubation period of 10 days. The smallest concentration appeared to be in the brain, after 5 days incubation.

TABLE 1

Materials tested	1st Passage		2nd Passage		3rd Passage	
	5 days Inc.	10 days Inc.	5 days Inc.	10 days Inc.	5 days Inc.	10 days Inc.
Allantoic fluid	4/8*	0/8	8/8	5/8	1/5	5/5
Amniotic fluid	1/6	7/8	5/7	8/8	5/5	2/5
Chorioallantoic membrane	7/8	5/8	8/8	7/7	3/5	5/5
Brain	2/8	7/8	0/8	7/8	0/5	4/5
Corpus minus CNS	8/8	8/8	1/8	7/7	5/5	5/5

* Numerator represents the number of mice which became infected; denominator represents the number of mice inoculated.

A distribution study in harvests from eggs representing the fourth passage of FA virus has also been made. The results indicate that the virus is also present in the yolk sac, in a somewhat lower concentration than in the corpus minus the CNS.

Because of the similarities between the Theiler viruses and poliomyelitis virus (*5*), we are using the present results as a guide for the propagation in eggs of a rodent adapted strain of human poliomyelitis virus.

References

1. Burnet, F. M., and Faris, D. D. *J. Bact.*, 1942, **44**, 241.
2. Gard, S. *Acta Med. Scand.* (Suppl.), 1943, 143.
3. Jungeblut, C. W., and Sanders, M. *J. exp. Med.*, 1940, **72**, 407.
4. Parker, R. C., and Hollender, A. *Proc. Soc. exp. Biol. Med.*, 1945, **60**, 88.
5. Theiler, M., and Gard, S. *J. exp. Med.*, 1940, **72**, 49.

Seed Pitting of the Lima Bean by Lygus Bugs in California

Kenneth F. Baker and William C. Snyder
Division of Plant Pathology, University of California
Los Angeles and Berkeley

Lima beans grown in California for dry food, seed, the fresh market, and freezing have for some years shown a pitting of the seeds indistinguishable from that attributed to yeast (Nematospora) in the southeastern United States (*10*). However, no Nematospora or other pathogen has ever been found in lesions of California material. The injury may be a discolored spot centering on a minute feeding puncture, but in more severe cases or when several such spots coalesce, an open corroded pit is evident in the seed coat and cotyledon. Such injuries have been called aphid spot, yeast spot, or seed pitting by growers and shippers. Accompanying this condiiton is the shedding of blossoms and of pods up to two inches or more in length. The pods which wilt, turn yellow, and abscise are termed "buckskins" by growers and have been attributed to other causes, such as heat injury, or to steaming from irrigation after the vines have covered the ground. Pods containing pitted seeds cannot be detected positively by external examination alone. However, they frequently exhibit internal proliferations and brown areas, some of which contact the pits of the seeds.

---

[3] ID$_{50}$ = infective dose that produces the disease in 50 per cent of mice inoculated.

These several types of injuries have now been demonstrated to result from the toxic feeding of Lygus bugs (*Lygus hesperus* Knight, *L. elisus* V.D., and perhaps others) on the developing fruiting structures of the Lima bean plant without the involvement of pathogenic microorganisms. It seems desirable at this time to clarify the situation in California, the leading Lima-bean-producing area of the country, and to indicate the impossibility of distinguishing this trouble, solely on the basis of symptoms, from that attributed to yeast.

Pitting of field-bean seeds apparently was first reported (*2*) in Michigan in 1895 and shown to be a result of Lygus feeding. This relationship has been confirmed in New York (*3*) and Idaho (*5*) and has been shown to occur also on the baby Lima bean in the latter state. Specimens of injured California beans submitted to W. E. Shull were said to be identical with those which resulted from Lygus feeding in Idaho. Pitting was reported (*1*) on Lima beans from California in 1922 and was attributed, apparently on the basis of symptoms, to yeast spot. That the seed pitting, and blossom and pod drop of Lima beans in California actually resulted from Lygus feeding was first suspected by the writers following visits to fields in Ventura County in August 1944, and subsequent work has confirmed this relationship. Such injury has been observed on large and baby Lima bean and blackeyed cowpea, but not on common bean.

Fields with severe blossom and pod drop tend also to have abundant seed pitting and, in Ventura County, a high incidence of Lygus bugs. In some areas, however, the Lygus populations late in the season may become too low to account for the evident damage initiated earlier. The injury has been worst in fields adjacent to seed beets and to alfalfa, particularly after it is cut. Damage also has been worst in parts of Lima bean fields closest to these established, favorable hosts of the insects, and within such areas the loss commonly diminishes with distance. The first crop of pods are not usually injured, but with the high Lygus populations of midsummer, much pod shedding and seed pitting occurs.

Lygus bugs commonly feed on flowers and fruits or seeds and are known to cause severe blossom drop on alfalfa (*8, 9*) and cotton (*6*) and to reduce germination of beet seed (*4*); they have been shown (*7*) to be highly toxicogenic. The observed facts in California are in accord with published data on the injuries produced by these insects on various plants, including common and Lima beans.

Experiments in which Lygus bugs were caged on plants in the field and on individual pods in the greenhouse fully confirmed the fact that they produced the various types of injury. Dropping of blossoms and young pods always resulted, and on older pods the internal proliferations and typical pitting of the seed occurred within seven days. Checks remained uninjured. There was no evidence of yeast or other microorganisms in the tissues.

The results establish the fact that the toxic feeding of Lygus bugs is responsible in the California Lima bean crop for a seed spotting and pitting, and for some of the dropping of blossoms and pods. It is possible that other insects also may be involved. Details are being published elsewhere.

References

1. ANDERSON, H. W. *Phytopathology*, 1924, **14**, 31.
2. DAVIS, G. C. *Mich. St. Bd. Agric., Ann. Rep.*, 1897, **55**, 136.
3. HAWLEY, I. M. *N. Y. (Cornell) agric. exp. Sta. Mem.* *55*, 1922.
4. HILLS, O. A. *J. agric. Res.*, 1943, **67**, 389–394.
5. SHULL, W. E. *Ida. agric. exp. Sta. Res. Bull.* *11*, 1933.
6. SMITH, G. L. *Calif. agric. exp. Sta. Bull.* *660*, 1942.
7. SMITH, K. M. *Ann. appl. Biol.*, 1920, **7**, 40–55.
8. SMITH, R. F., and MICHELBACHER, A. E. *Calif. St. Dept. Agric. Bull.*, 1944, **33**, 39–52.
9. SORENSON, C. J. *Ut. agric. exp. Sta. Bull.* *284*, 1939.
10. WINGARD, S. A. *Phytopathology*, 1922, **12**, 525–532; *Bull. Torrey bot. Club*, 1925, **52**, 249–290.

Oral Penicillin X[1]

MANSON MEADS, EDWIN M. ORY, and
MAXWELL FINLAND

Thorndike Memorial Laboratory, Boston City Hospital
and
Department of Medicine, Harvard Medical School

A brief resumé of some of the properties of penicillin X and the results of a clinical trial in gonorrhea were recently published by workers of the Food and Drug Administration (*4*). It was shown that, unit for unit, penicillin X is superior to the usual commercial preparations of penicillin in acute gonorrhea and in protecting mice against pneumococcal infec-

---

[1] Accepted for publication on 12 September 1945.

tion. Simultaneous *in vitro* tests were carried out in this laboratory with commercial lots consisting almost entirely of penicillin G and with preparations containing 65 per cent or more of penicillin X. Most strains of Group A hemolytic streptococci, gonococci, and meningococci were from two to eight times more sensitive to penicillin X; most strains of pneumococcus and of *Streptococcus viridans* were twice as sensitive to penicillin X, and most of the staphylococci were equally sensitive to both forms of penicillin. Levels of penicillin activity in the serum against Strep. 98 were studied and found to be significantly higher and to be sustained longer after intramuscular injections of penicillin X than after injections of the same number of units of regular penicillin in the same subjects (*2*).

Similar studies of the levels of penicillin activity in the serum after oral administration of the two kinds of penicillin have also been carried out. The results were strikingly different and are the subject of the present report.

The methods used and the injectable preparations of penicillin X were the same as in the previous studies (*2*). In addition, tablets of regular calcium penicillin and of penicillin X, each containing about 30,000 I.U. (*3*) with certain adjuvants, were also available for these studies.[2] Subjects A, B, and C were members of the laboratory staff; D, E, and F were hospital patients who had no recent infections and had not recently received penicillin or sulfonamides, but subject F had a duodenal ulcer with normal gastric acidity; and subjects G, H, and I were cases of pernicious anemia with gastric anacidity after histamine injections. All of the oral doses consisted of 90,000 units and were given one-half hour before breakfast. Previous studies have shown that higher, better-sustained, and more uniform serum levels are obtained when oral doses are given before meals (*1*).

The results are shown in Fig. 1. In interpreting these results it must be borne in mind that Strep. 98, the strain used in determining the serum levels, was found to be from two to four times more sensitive to the preparations of penicillin X than to the commercial penicillin used in the present studies. The unitage as recorded on the chart is based on the sensitivity of Strep. 98 to penicillin G: 0.02 and 0.03 units represent complete killing of 10,000 streptococci contained in 0.5 cc. and 0.2 cc., respectively, of undiluted serum, and the other values are based on serial twofold dilutions of 0.2 cc. of serum. The same values are recorded for regular penicillin and for penicillin X.

In each of the six subjects who received the two kinds of penicillin in solution, the effective serum levels were significantly higher and were sustained better when regular penicillin was given. Comparable differences were observed in the normal subjects and in the cases of pernicious anemia. When the tablets were given, there was no constant or significant difference in the serum levels after the two kinds of penicillin. Except in subject F, however, the maximum serum levels after the regular penicillin were the same or higher than those obtained after penicillin X. As in the previous study (*1*), higher and more sustained levels from oral doses were obtained in the achlorhydric subjects. In view of the greater sensitivity of the test strain of streptococcus, the higher values obtained after the regular penicillin assume an even greater significance than is apparent from the values shown in the chart.

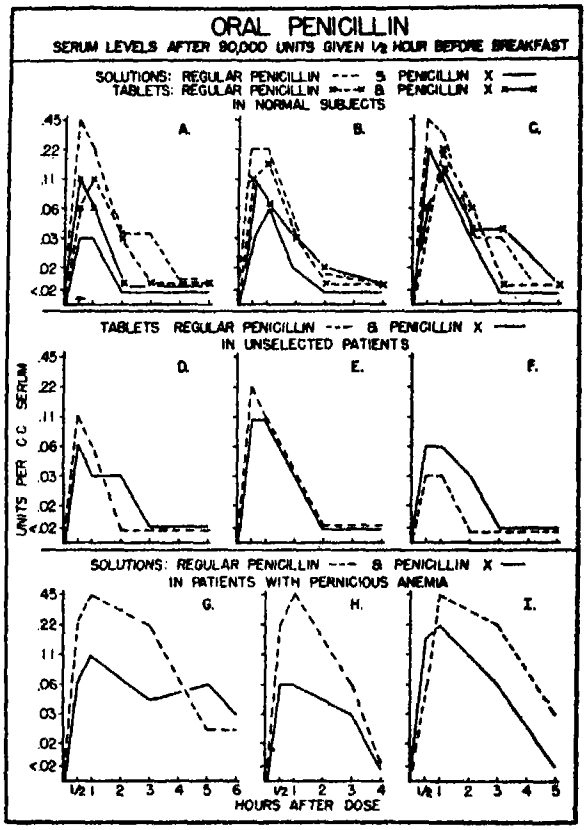


Fig. 1

Conclusions. When measured with Strep. 98, an organism which is two to four times more sensitive to penicillin X than to regular penicillin, the effective levels of penicillin activity in the serum were found to be higher in the same subjects after regular penicillin than after comparable preparations of penicillin

---

[2] Injectable penicillin X was supplied by Lederle Laboratories, Inc., and by Cutter Laboratories, the former also providing the tablets of penicillin X. Tablets of regular calcium penicillin were furnished by Hoffmann-La Roche, Inc. Commercial preparations of several brands of regular sodium penicillin were used for solutions.

X, each given orally. The results are in sharp contrast to those obtained after intramuscular injections of these two kinds of penicillin and suggest that penicillin X is not absorbed as well as penicillin G after oral administration.

References

1. Finland, Maxwell, Meads, Manson, and Ory, E. M. *J. Amer. med. Ass.*, 1945, **129**, 315.
2. Ory, E. M., Meads, Manson, and Finland, Maxwell. *J. Amer. med. Ass.*, 1945, **129**, 257.
3. Veldee, M. N., Herwick, R. P., and Coghill, R. B. *Science*, 1945, **101**, 42.
4. Welch, Henry, Putnam, L. E., Randall, W. A., and Herwick, R. P. *J. Amer. med. Ass.*, 1944, **126**, 1024; VanWinkle, W., Jr., and Herwick, R. P. *J. Amer. pharm. Ass.* (Sci. ed.), 1945, **34**, 97.

The Beckmann Rearrangement of Aliphatic Ketoximes

A. D. McLaren

Department of Chemistry, University of Buffalo

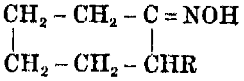
Sidgwick (*8*) states that the Beckmann transformation of methyl *n*-propyl ketoxime results in the formation of two amides, whereas the analogous rearrangement of methyl isopropyl ketoxime gives but one. From this he argues for the existence of steric interaction between the hydroxyl and isopropyl groups of the latter oxime, which would prevent the formation of the alternate amide. This argument cannot hold, because of an apparent oversight in previous literature. Although Beilstein (*1*) gives the above information concerning the two rearrangements, reference to the original paper (*4*) shows that in all cases investigated all possible products were formed from

$$CH_3\text{-}C(=NOH)\text{-}R \qquad \text{I}$$

where R may be propyl or isopropyl as well as ethyl or hexyl. In each of these cases the amide with the configuration

$$CH_3\text{-}CONH\text{-}R \qquad \text{II}$$

was found in the greater proportion, but lesser amounts of $R\text{-}CONH\text{-}CH_3$ were also detected in every instance. Thus, the statement by Sidgwick, "It is unlikely that the electrical fields of the propyl and isopropyl groups are widely different, but the space they occupy in the vicinity of the oxime hydroxyl group must differ," is not necessarily relevant. Kharasch (*9*) has demonstrated that the electrical fields of the methyl, propyl, and isopropyl groups do differ enough to direct the course of certain reactions. Hence, the relative electronegativity of CH_3– as compared with that of R may still be a deciding factor on the course of the rearrangement. This consideration of oximes (I) with R as propyl or isopropyl is important where prediction is to be applied to the course of rearrangement of 2-alkylcyclohexanone oximes (III)



$$\begin{array}{l} CH_2-CH_2-C=NOH \\ | \qquad\qquad\quad\; | \\ CH_2-CH_2-CHR \end{array} \qquad \text{III}$$

where R may also be methyl. The similarity in structure of (I), where R is isopropyl and (III), where R is methyl, is obvious from the formulas. In most of these cases (*6, 7, 10*) only one of the two possible products is found. However, at least one exception has been found (*11*) which now no longer seems anomalous in view of the corrected statement of earlier findings for methyl isopropyl ketoxime. Unfortunately, no quantitative information was given by Wallach for 2,4,4-trimethylcyclohexanone oxime (*11*), and the identity of the products was not established.

Higman (*5*) has recently presented a mechanism for the Beckmann rearrangement which does not involve the classical migration of groups (see chapter on the Beckmann rearrangement, *8*) but only a 90° twist by C = N in an oxime, followed by a small angular displacement of substituents. With the electronegativity considerations of Degering (*2*) in mind, we may look upon the segment C = N as a dipole with a relatively positive nitrogen atom. The minimum rotation of C = N would then be preferred in the direction of the more negative (greater electron releasing) R rather than toward methyl or methylene (*9*), although some product from the alternate course of reaction would be expected and has been found (*4, 11*). Through similar qualitative considerations Degering was able to predict the course of the reaction of 2-alkylcyclohexanone oximes (*3*) whereby products similar to (II) were formed. It is hoped that this discussion will help to tie together the early and recent work on the rearrangement of aliphatic ketoximes.

References

1. Beilstein. *Handbuch der organischen Chemie.* Leipzig: Julius Springer, 1918. Vol. **1**, p. 683.
2. Degering, E. F. *Ind. Acad. Sci.*, 1942, **52**, 135.
3. Degering, E. F. Private communication, 8 July 1944.
4. Hantzsch, A. *Ber.*, 1891, **24**, 4018.
5. Higman, B. *Nature, Lond.*, 1945, **156**, 242.
6. Hildebrand, J. G., and Bogert, M. T. *J. Amer. chem. Soc.*, 1936, **58**, 650.
7. McLaren, A. D., and Pitzl, G. *J. Amer. chem. Soc.*, 1945, **67**, 1625.
8. Sidgwick, N. V. *The organic chemistry of nitrogen.* London: Oxford Univ. Press. 1937. P. 191.
9. Towne, E. B. *Synth. org. Chem.*, 1944, **16**, No. 4.
10. Ungnade, H. E., and McLaren, A. D. *J. org. Chem.*, 1945, **10**, 29.
11. Wallach, O. *Ann. Chem.*, 1906, **346**, 258.

Penicillin Production by a Superior Strain of Mold

Marvin J. Johnson, J. J. Stefaniak, F. B. Gailey, and B. H. Olson

Department of Biochemistry, University of Wisconsin

The figures given in this note represent a small part of the data obtained during the course of an investigation of factors influencing fermentation time and yield in penicillin production in submerged cultures, the results of which will be published in more detail elsewhere. It is the purpose of this note to summarize briefly the results obtained when a number of penicillin-producing mold cultures were tested in 80-gallon tanks.

The cultures were isolated by laboratories at Stanford University (Department of Biology), the University of Minnesota (Division of Plant Pathology and Botany), and the Carnegie Institution of Washington (Department of Genetics). These laboratories, as well as our own, carried on penicillin research projects as a part of a program supported by the Office of Production Research and Development of the War Production Board. The testing of the most promising of these strains in tank fermentations at Wisconsin was a part of this program. The tanks used were of 80-gallon capacity and contained 220 liters of medium, 20 liters of which was inoculum grown in a smaller tank under aeration and agitation. The tanks were supplied with air at the rate of 200 liters per minute. Sterile air was admitted through pipe spargers containing 54 holes, each 1/32 in. in diameter. The agitators used were 12-in. propellers having two flat blades, set at a 30° angle, and revolving at 270 r.p.m. The tanks were held at gage pressure of 20 pounds per square inch during the fermentation period. The temperature was held at 23° C.

TABLE 1

Highest Penicillin Yields Obtained from Various Cultures*

Culture number	Source of culture	Highest yield obtained	Age at maximum yield	Comparable yield from culture 1951–B25†
		Units/ml.	Hours	Units/ml.
1951–B25	NRRL	245	64	...
832	NRRL	99	71	214
15–U1	Minnesota	222	68	245
R–88	Minnesota	135	55	172
R–1139	Minnesota	96	74	214
R–1205	Minnesota	101	69	214
1982	Stanford	119‡	64	103
25099	Stanford	244	62	184
35217	Stanford	275	84	245
35347	Stanford	255	72	245
45417	Stanford	229	69	214
X–1612	Carnegie	557	72	214

* The medium contained 4 per cent corn steep liquor (dry basis), 3 per cent lactose, and 1 per cent calcium carbonate.

† Because the yield on the reference cultures varied, the yield on the culture tested should be compared with the reference culture yield given in this column, which was determined at the same period under the same conditions.

‡ No calcium carbonate was used. The medium was adjusted to pH 6.5 with NaOH.

In Table 1 are listed the highest yields obtained with each of the cultures tested in tanks. Highest yields on two cultures obtained from the Northern Regional Research Laboratory of the U. S. Department of Agriculture are included for comparison, since these have been widely used and may be regarded as reference cultures. The last column of the table gives yields obtained on one of the reference cultures under conditions comparable with those under which the new culture was tested. This column is included because of the presence of a substantial degree of uncontrolled variability, due to changes in the composition of the corn steep liquor used and to unknown factors.

As may be seen from the table, only one of the new cultures, No. X–1612, gave a yield greatly in excess of that obtained with culture No. 1951–B25. Culture X–1612 is an X-ray mutant from *Penicillium chrysogenum* culture No. 1951–B25 of the Northern Regional Research Laboratory. This X-ray mutant was produced at the Carnegie Institution and after preliminary tests was forwarded for further testing to the University of Minnesota, where its performance in shaken flask cultures resulted in its being included with a group of promising Minnesota cultures forwarded to the University of Wisconsin for larger-scale tests.

TABLE 2

Effect of Nutrient Level on Yield of Culture X–1612*

Composition of medium				Yield	Age at maximum yield
Corn steep liquor (solids)	Lactose	$CaCO_3$	Salts†		
Per cent	Per cent	Per cent		Units/ml.	Hours
2	2	0.2	+	239	54
4	3	1	–	480	64
6	3	1	–	636	67

* The fermentation conditions were those described in Table 1.

† The salts added per liter of medium were 0.25 gram KH_2PO_4, 0.12 gram $MgSO_4 \cdot 7H_2O$, and 1.5 gram $NaNO_3$. At a low steep liquor concentration the use of an auxiliary nitrogen source is desirable.

The penicillin yield obtained with this culture is, of course, greatly influenced by the conditions of nutrition, aeration, and agitation under which it is grown. Illustrative data on the effect of nutrient level at a high aeration rate are given in Table 2. It will be noted that in the presence of excess lactose (unfermented sugar remained at the end of each of the fermentations) the penicillin yield is a function of the corn steep liquor level used.

Addendum: It is regretted that publication delay has caused this preliminary report to lose some of its significance during the interval since the manuscript was submitted on 30 July 1945. Since that time a number of papers describing work in which Culture X-1612 was used have appeared in this journal and elsewhere, from this and from other laboratories.

The Evolution of Oxygen From Illuminated Suspensions of Frozen, Dried, and Homogenized Chloroplasts

C. S. French, A. S. Holt, R. D. Powell
University of Minnesota
M. L. Anson
Continental Foods, Inc., Hoboken, New Jersey

The evolution of oxygen from suspensions of chloroplasts in solutions containing ferric oxalate and potassium ferricyanide was discovered by Hill and Scarisbrick (*5*). The possible relation of this photochemical and enzymatic reaction to the process of oxygen evolution by green-leaf photosynthesis and further details of the reaction have been discussed by various authors (*1, 2, 3, 4, 6, 7, 8*). It is the purpose of this note to summarize some data on the activity of chloroplast preparations that have been treated in various ways.

The significance of this work lies in the fact that chloroplast preparations are shown to be amenable to some treatments, such as would be necessary for the separation of their active components. By the use of similar preparations it may be possible to study some of the enzymes involved in a reaction which is initiated by light absorbed by chlorophyll and which results in oxygen evolution.

The participation of an enzyme system in the reaction appears to be indicated from the thermolability of the preparation and also from the inhibition by low concentrations of enzyme poisons such as NH_2OH, Duponol, NaF, and NaN_3. The Hill reaction is considerably less sensitive to NaN_3 than is the catalytic decomposition of H_2O_2 by chloroplasts.

Concomitant with the oxygen evolution there is also a production of H^+ which affords a simple means of measuring the reaction velocity. We have used a constant pH titration procedure for many of the activity measurements. In order to obtain quantitative results it is necessary to use a red filter to prevent the effects of light on the reagents themselves at high light intensity. The pH optimum was found to be at pH 7.0 or 7.5, depending on the conditions of measurement. Higher rates and a greater total evolution of oxygen *were found if nitrogen was used instead of air in the* manometer vessels. Temperatures of about 10° are most suitable for the measurement of this reaction, since the activity is rapidly lost at room temperature. Chloroplasts suspended in solutions of potassium ferricyanide alone were found to produce oxygen when illuminated, but at a lower rate than when ferric oxalate was also present. Supersonic irradiation breaks up the chloroplasts to give solutions which, when centrifuged for ½ hour at *ca.* 20,000g, are green and appear clear but show the Tyndall scattering effect in an intense beam of light. The effects of various treatments on the activity of preparations of chloroplasts in ferric oxalate solution with ferricyanide are shown in Table 1.

TABLE 1

THE INFLUENCE OF VARIOUS TREATMENTS ON THE PHOTOCHEMICAL O_2 EVOLUTION BY CHLOROPLASTS IN A SOLUTION CONTAINING FERRIC OXALATE AND POTASSIUM FERRICYANIDE

Original material	Treatment	Per cent of original activity retained after treatment
Suspension of intact chloroplasts in 0.5 M sucrose	Frozen 15 hr.	72
"	Disintegrated in blender	54
Suspension of intact chloroplasts washed with water	Lyophilized	69, 31
"	Dried with molten $Na_2SO_4 \cdot 10 H_2O$	78, 69
Suspension of intact chloroplasts in 0.5 M sucrose	Supersonic 1 min.	118
"	Supersonic 1 min. followed by ½ hr. centrifugation at 800g. Supernatant used after 15 hr. at 0°	81
Suspension of chloroplasts in water	Supersonic 1 min., centrifuged at 20,000g for ½ hr. Supernatant green solution used.	134
"	Sediment from the above centrifugation.	0
Fragments of leaves after 5 min. in blender strained, collected by centrifugation for ½ hr. at *ca.* 20,000g	Washed by suspension in water, recentrifuged, precipitate used.	57
	Above plus boiled water extract of leaves.	100
	Precipitated with ½ saturation $(NH_4)_2SO_4$	94, 85, 54, 55, 67

From these data it is seen that freezing, drying, thorough disintegration of the chloroplasts, or precipitation by ammonium sulfate results in preparations that still retain considerable activity. In conclusion, we may say that these experiments show that the ability to produce oxygen is a property not only of intact chloroplasts but also of material which has been exposed to some of the conditions that would be necessary in attempts to fractionate the enzymes involved in the reaction by which oxygen is produced.

Addendum: The papers of Warburg and Lüttgens (*9*), announcing the discovery of a similar reaction of chloroplasts which form oxygen and hydroquinone with an energy uptake of 52,000 calories, supplied by light, have recently become available to us. The quinone reaction appears even more promising than the one here described as a means of investigating the mechanism of photosynthetic oxygen evolution in green plants.

References

1. French, C. S., and Anson, M. L. *Amer. J. Bot.*, 1944, **31**, 9s. (Abstract.)
2. French, C. S., Newcomb, E., and Anson, M. L. *Amer. J. Bot.*, 1942, **29**, 8s. (Abstract.)
3. French, C. S., and Rabideau, G. S. *J. gen. Physiol.*, 1945, **28**, 329.
4. Hill, R. *Nature, Lond.*, 1937, **139**, 881; *Proc. roy. Soc.*, 1939, **127B**, 192.
5. Hill, R., and Scarisbrick, R. *Nature, Lond.*, 1940, **146**, 61.
6. Hill, R., and Scarisbrick, R. *Proc. roy. Soc.*, 1940, **129B**, 238.
7. Johnston, E. S., and Myers, J. *Annu. Rev. Biochem.*, 1943, **12**, 473.
8. Kumm, J., and French, C. S. *Amer. J. Bot.*, 1945, **32**, 291
9. Warburg, O., and Lüttgens, W. *Naturwiss.*, 1944, **32**, 161, 301.

Association Affairs

The One Hundred Twelfth Meeting of the American Association for the Advancement of Science

F. R. Moulton

Permanent Secretary, AAAS, Washington, D.C.

THE ONE HUNDRED TWELFTH MEETING of the American Association for the Advancement of Science was held in St. Louis, Missouri, 27–31 March 1946, inclusive. At this meeting, the fifth held in St. Louis, a completely revised constitution of the Association was formally adopted by the Council. The preceding constitution of the Association was adopted at the third St. Louis meeting, held in December of 1919.

Never before has the Association held an annual meeting under such trying conditions. The prohibition on the holding of meetings by the Office of Defense Transportation was removed so late in the year that only three months were available for preparations for the St. Louis meeting. An obvious suggestion would be that it should have been held later or in some other city. The answers to this suggestion are that there was no other city which would undertake to provide even limited accommodations for such a large meeting and that there were no other four consecutive days in which some other convention had not been scheduled for St. Louis. Since only one meeting of the Association had been held in the preceding four years, and since the next available time for a meeting would be a year later (in December 1946), it was decided to proceed with plans in spite of difficulties.

The St. Louis meeting was not a simple convention but a joint meeting of 41 independent societies and 13 sections of the Association. All meeting arrangements for these 54 organizations, including rooms and facilities for 229 sessions, were made by the staff of the Association. In order to provide accommodations for them it was necessary to have 58 different meeting rooms, many of which had to be equipped with projection apparatus. At times as many as 40 sessions were held simultaneously, necessitating the use of practically all suitable meeting rooms throughout the city. The most difficult problem, however, was that of providing living accommodations for those attending the meeting. The St. Louis Convention and Publicity Bureau gave the Association unfailing cooperation and assistance in obtaining rooms in all possible places, including hotels, local educational institutions, and private homes. Written appeals for assistance were sent by the Association to its 300 members in St. Louis, and they generously extended it up to the limits of their capacities to accept temporary guests in their homes. Despite these efforts it was necessary to send notices to several hundred applicants for accommodations that rooms would not be available. The serious shortages in accommodations were indirect consequences of the war and were almost invariably accepted by scientists with the same fortitude exhibited by them in meeting hardships throughout the war.

REGISTRATION

A much large number of scientists attended the meeting than was expected under the existing unfavorable conditions, with the result that copies of the General Program were exhausted on the second day, at which time the registration was far from complete. Nevertheless, 2,649 persons from 46 states, the District of Columbia, and 14 foreign countries registered as follows: Alabama, 19; Arkansas, 24; California, 49; Colorado, 22; Connecticut, 37; Delaware, 8; District of Columbia, 53; Florida, 15; Georgia, 23; Illinois, 436; Indiana, 120; Iowa, 111; Kansas, 60; Kentucky, 16; Louisiana, 23; Maine, 6; Maryland, 56; Massachusetts, 48; Michigan, 132; Minnesota, 80; Mississippi, 17; Missouri, 530; Montana, 2; Nebraska, 47; Nevada, 2; New Hampshire, 1; New Jersey, 37; New Mexico, 5; New York, 182; North Carolina, 15; North Dakota, 11; Ohio, 115; Oklahoma, 61; Oregon, 1; Pennsylvania, 65; Rhode Island, 3; South Carolina, 12; South Dakota, 7; Tennessee, 35; Texas, 58; Utah, 6; Vermont, 1: Virginia, 39; Washington, 7; West Virginia, 10; Wisconsin, 100; Wyoming, 5; Argentina, 2; Belgium, 1; Brazil, 1; Canada, 13; China, 1; Cuba, 1; England, 2; Hawaii, 4; India, 3; Mexico, 4; Panama, 1; Puerto Rico, 3; Siam, 1; Venezuela, 1.

The distribution of the registrants proves that the St. Louis meeting was national, and even international to a considerable degree; the general program and the reports which follow show that the papers presented ranged widely over the numerous fields of the natural and the social sciences. After a long dearth of scientific meetings scientists could well afford to endure some inconveniences for such opportunities for conferring with their fellow scientists.

GENERAL SESSIONS

Four general sessions open to the public were held. On Wednesday evening, 27 March, the retiring president of the Association, Dr. Anton J. Carlson, delivered an address before a large and appreciative audience on: "Is There 'a Standard to Which the Wise and the Honest Can Repair?' " Dr. James B. Conant, president of the Association for 1946, presided. Dr. Carlson's address was printed in full in *Science*, 1946, **103**, 377–382.

On Thursday evening, 28 March, the twenty-second Annual Lecture under the joint auspices of the Association and the Society of the Sigma Xi was delivered by Dr. E. C. Stakman, of the University of Minnesota, whose topic was: "Progress and Problems in Controlling Diseases of Crop Plants." This session, of which Dr. Conant was chairman, was well attended and enthusiastically received.

At the third general session, held on Friday evening, 28 March, Dr. Irwin Edman delivered the ninth Annual Lecture sponsored jointly by the Association and the United Chapters of the Phi Beta Kappa. Dr. Edman's address, on "Science and the Dream of Happiness," was listened to with much pleasure by an exceptionally large and distinguished audience. Dr. Arthur H. Compton, a former president of the Association and recently elected chancellor of Washington University, presided at the meeting and introduced Dr. Edman.

The illustrated lecture sponsored jointly by the National Geographic Society and the Association drew an audience that filled to overflowing the large opera house of the Kiel Auditorium. Mr. Luis Marden, staff photographer and writer of the National Geographic Magazine, delivered an address on "Seeing Costa Rica," which was illustrated by colored motion pictures.

Meeting of the Council of the AAAS

Hotel Jefferson, St. Louis, Missouri, 27 March 1946, 2:00 P.M.

Otis W. Caldwell
General Secretary, AAAS

The presiding officer, A. J. Carlson, chairman of the Executive Committee, asked Secretaries Moulton and Meyerhoff to present items of business recommended by the Executive Committee.

1. It was moved by B. E. Livingston that the official year of the AAAS shall be the same as the calendar year. The motion was passed unanimously.

2. It was moved by B. E. Livingston that the Cleve-

land meeting of the AAAS be declared the annual meeting for 1944, and that the St. Louis meeting be declared the 1945 meeting of the AAAS. The motion was passed unanimously.

3. Secretary Meyerhoff reported the recommendation of the Executive Committee that the Revised Constitution in the exact wording as presented at Cleveland, 1944 annual meeting, be presented at the general meeting of the AAAS at the night meeting at St. Louis, 27 March 1946. This report of the Executive Committee does not require action by the Council.

4. The Permanent Secretary's financial report for the year 1945 and proposed budget for 1946 were presented and approval asked. There was discussion by Secretaries Meyerhoff and Moulton. The 1944 financial statement, previously printed, was also discussed.

B. E. Livingston moved and Kirtley Mather seconded that the 1944 financial report be approved. The motion was passed unanimously.

B. E. Livingston moved and Kirtley Mather seconded that the 1945 report be approved and ordered audited and printed. The motion was passed unanimously.

5. Secretary Moulton reported the present status of the building fund, stating that almost $100,000 has been contributed. Secretary Meyerhoff urged cooperation on further contributions.

6. Secretary Moulton reported a Philadelphia proposal regarding a permanent home for the AAAS in Philadelphia. No action was taken.

7. The place of the next meeting was presented. It was moved and seconded that the meeting of December 1946 be held in Boston, Massachusetts. The motion was passed unanimously.

8. Applications for affiliations or association with the AAAS were presented.

a. Society of Economic Geologists—data presented by Secretary Meyerhoff. W. R. Miles moved and Kirtley Mather seconded that it be affiliated. The motion was passed.

b. American Society for Aesthetics—data presented by Secretary Meyerhoff. A motion by the latter, seconded by F. E. E. Germann, recommending its acceptance as an associated society was passed.

c. Academy of World Economics—data presented by Secretary Meyerhoff. Kirtley Mather moved and Otis W. Caldwell seconded that it be affiliated. The motion was passed.

d. Pi Gamma Mu asked change from association to affiliation. A motion to this effect by Secretary Meyerhoff, seconded by Anton J. Carlson, was passed.

e. Beta Beta Beta, Honorary Historical Society—data presented by Secretary Meyerhoff, who moved, Kirtley Mather seconding, that it be affiliated. The motion was passed.

f. Herpetologists League—data presented by Secretary Meyerhoff. Secretary Moulton moved and W. R. Miles seconded that it be associated. The motion was passed.

g. American Society for Professional Geographers. Its affiliation was moved by Kirtley Mather and seconded by Otis W. Caldwell. The motion was passed.

9. Report was made to the Council by Secretary Moulton regarding publication of Proceedings of the AAAS. No Council action was required.

10. The following resolution by Section Q was presented by R. T. Shaw: That the Council of the AAAS authorize and direct the Executive Committee to set up a Legislative Committee whose powers and duties shall be prescribed by the Executive Committee. The number of members, their qualifications, and method of election or appointment shall be prescribed by the Executive Committee, subject to such modification as may be made from time to time by the Council.

It was moved by G. A. Baitsell and seconded by W. Kaempffert that the resolution be tabled, and the motion was lost. Discussion by Secretary Meyerhoff and W. Kaempffert followed. It was thereupon moved by Kirtley Mather and seconded by Dr. Millerton that the resolution be referred to the Executive Committee for study and report to the Council. The motion was passed.

11. It was moved by B. E. Livingston and seconded by Kirtley Mather that in the judgment of the Council the present committee on Science Legislation, which has been functioning for several months, should continue its functions. The motion was passed unanimously.

G. A. Baitsell expressed his opinion that officers of the Society appearing before legislative committees should be careful to make it clear that personal opinions are being expressed, except when their statements are based on a poll of the Council on the full membership.

12. A motion by Kirtley Mather that when the Council adjourns it shall adjourn to meet at 4:00 P.M. on Friday, 29 March 1946, was passed, as was a motion to adjourn.

Minutes of the Adjourned Meeting, 29 March 1946, 4:00 P.M.

The meeting was called to order at 4:15 P.M. by President James B. Conant. Minutes of the Council meeting held on 27 March 1946 were read, corrected, and approved.

1. President Conant reported the action of the Association on the Revised Constitution at the general session of the AAAS, Wednesday evening, 27 March 1946. It was stated to the Association that, in accordance with constitutional provisions and with the approval of the Council, it was proposed that the present Third Constitution of the Association (adopted at St. Louis in 1919) be amended by the ratification of a new Constitution. The proposed new text was published in *Science* on 1 September 1944, and was published again in the same journal on 1 March 1946. Since this same revision received a majority vote at the preceding general session of the Association (Cleveland meeting in 1944), a majority vote of the members present at the St. Louis general session would now ratify the Revised Constitution, and this new Constitution would then become the Fourth Constitution of the Association, effective one month later, *i.e.* on 27 April 1946. It was moved and seconded that the Revised Constitution be adopted.

President Conant called for a vote, reported that the vote was almost unanimous, and declared the Revised Constitution adopted, to be effective as of 27 April 1946.

2. W. R. Miles, who had acted as secretary of the preceding meeting of the Executive Committee, reported recommendations. It was moved by A. H. Compton and seconded by Otis W. Caldwell that the Executive Committee recommend to the Council that it approve the present Kilgore-Magnuson Bill, S. 1850, and that if this recommendation should secure a two-thirds affirmative mail vote of those voting, the Executive Secretary of the Association be thereby authorized to take all steps practical to facilitate the passage of S. 1850 through Congress, and that the president of the Association, Dr. Conant, be authorized to appoint a special committee, of which he is to serve as chairman and Secretary Meyerhoff as a member, which shall endeavor to carry through the intent of this motion.

It was moved by A. J. Carlson and seconded by Kirtley Mather that the above be endorsed and sent by mail ballot to the full Council. The motion was passed.

3. It was moved by A. J. Carlson and seconded by E. C. Stakman that the president of the Association be empowered to enlarge the Committee on Science Legislation by the appointment of three additional members, and that the Committee be instructed to expand its work of collecting and publishing information to include, if possible, all proposed congressional and state legislation affecting science. This motion was passed unanimously.

4. The financial report of the Permanent Secretary was accepted.

5. The resolution from Section Q, referred to in minutes of preceding Council meeting, was read by W. R. Miles. Drs. Martin, Shaw, Carlson, Urey, Mather, Stakman, Compton, and Conant spoke on the motion.

A motion by A. J. Carlson, seconded by E. G. Martin, that the Executive Committee be asked to study the resolution further to determine whether action is desirable, was carried by a vote of 17 in favor and 12 opposed, 9 persons present not voting.

6. Paul Weiss moved that the Council establish a Council in Methodology of Science. Such a group would study the content, objectives, methods, and procedures of science as used in research, education, and applications. It was moved by A. J. Carlson and seconded by W. R. Miles that this proposal be referred to the Executive Committee for further study. The motion was passed.

7. B. E. Livingston presented the following resolution of appreciation of the services given to the meetings of the AAAS by other citizens of St. Louis.

> The Council of the American Association for the Advancement of Science is glad to express its appreciative thanks to many institutions of St. Louis and to many people of the city for their helpful cooperation in making the fifth St. Louis meeting of the Association a successful one, despite some difficulties due to postwar conditions. Held from 27 to 30 March, this was the Association's 112th meeting.
>
> The Council appreciates the many facilities made available by the St. Louis Convention and Publicity Bureau, by the hotels of the city, by the St. Louis Academy of Science, and by Washington University and Saint Louis University. Cordial interest in the meeting was shown by the 26 members of the local advisory committee, by many other citizens, and by the general public of St. Louis. The local Press and the representatives of many metropolitan dailies and news syndicates provided amply for wide dissemination of news of this meeting throughout America and the world.
>
> Only the joint efforts of the public, through local organizations and individuals, and of the Association can effectively promote the advancement of science, and the Council welcomes this opportunity gratefully to acknowledge its debt.

Dr. Livingston moved its acceptance, W. R. Miles seconded, and the motion was passed.

8. President Conant, on request by A. H. Compton, briefly discussed proposed control of studies and uses of atomic energy. A general discussion followed.

9. By vote, the Council adjourned at 5:40 P.M.

Sections and Societies

Howard A. Meyerhoff

Executive Secretary, AAAS, Washington, D.C.

Mathematics

Section A, Mathematics, held three sessions, in addition to a luncheon on Saturday. The attendance was about 95.

On Friday afternoon, 29 March, L. M. Blumenthal, University of Missouri, spoke on "Some Metric Peculiarities of Elliptic Space," and J. L. Walsh, Harvard University, delivered his address as retiring vice-president of the Association and chairman of Section A on "Taylor's Series and Approximation to Analytic Functions." R. E. Langer, vice-president and chairman elect of Section A, presided.

On Saturday morning R. R. Middlemiss, Washington University, the chairman of the Missouri Section of the Mathematical Association of America, presided at a joint session of the Missouri Section and Section A. G. M. Ewing, University of Missouri, spoke on "Problems Arising From the Introduction of High School Mathematics Into the Colleges"; A. E. Ross, Saint Louis University, spoke on "A Course in the Interpretation of Basic Mathematical Concepts for Teachers in Secondary Schools"; and S. E. Warschawski, University of Minnesota, delivered an invited address on "Some Convergence Theorems in Conformal Mapping."

W. H. Roever, Washington University, presided at the Saturday luncheon for mathematicians at the DeSoto Hotel, and Prof. Langer spoke informally on immediate problems of departments of mathematics in the universities.

On Saturday afternoon, G. W. Snedecor, Iowa State College, presided at a joint session of the Institute of Mathematical Statistics and of Section A. Invited addresses were delivered by Cdr. J. H. Curtiss, USNR, on "Statistical Inference and Its Engineering Applications," and by M. H. Hansen, Bureau of the Census, on "Some Sampling Problems in Surveys of Business and Population." (*From reports by R. W. Brink and P. S. Dwyer.*)

Physics

The meeting of Section B, Physics, was held Friday morning, 29 March. About 125 persons attended. During the vice-presidential address the chair was taken by A. L. Hughes, of Washington University. R. C. Gibbs, vice-president of the Association and chairman of Section B, chose as his title "Whither Physics?" and discussed the problems facing physics as a result of the expansion of its activities during the war. Rear Adm. Bowen, USN, chief of the Office of Research and Inventions, spoke on "The Navy in Research," followed by Capt. M. J. Lawrence, USN, on "How the Navy Implements Its Research Program." Two invited papers on the application of physics to biology followed, one by Francis O. Schmitt, of the Massachusetts Institute of Technology, on "X-ray Diffraction and Electron Microscope Studies of Cell Structure," and the other by M. D. Kamen, of Washington University, on "The Use of Radioactive Tracers in Biological Research." (*From a report by Joseph C. Boyce.*)

At the meeting of the American Meteorological Society, six papers were presented: (1) "Storms and Origin of Microseisms," by James B. Macelwane, S.J.; (2) "Tracking Hurricanes With the Seismograph," by M. H. Gilmore (read by Fr. Macelwane); (3) "The Effect of Varying Pressure Gradients on the Trajectory of Air Parcels," by Lester Machta, Sr.; (4) "A High Altitude Meteorological Research Program," by Lt. Cdr. Daniel F. Rex; (5) "Heavy Snow Situations at Kansas City," by Oscar Tenenbaum; and (6) "Some Theorems of Vorticity and Development," by Lt. N. R. Beers.

The first two papers brought forth convincing evidence that severe cyclones cause an increase in the amplitude of microseisms, and that hurricanes can be mapped from the seismic disturbances resulting from them. This discovery ranks, along with storm location by radar and by aircraft reconnaissance, as the most significant contribution to the tracking of tropical storms since I. M. Cline first realized the importance of storm tides as a means of following their path (1900). The third paper showed that a noticeable error would result from the use of gradient winds in computing air trajectories because of the large magnitudes of the departures from the gradient winds associated with the accelerations of changing pressure gradients. The fourth paper outlined a new method of obtaining meteorological measurements at very high altitudes, from 100,000 to 500,000 feet, by the use of fully equipped rockets. The fifth paper was illustrated with weather maps showing four types of synoptic situations which may produce heavy snowstorms in the vicinity of Kansas City. The final paper treated certain phases of the subject of vorticity from an original theoretical viewpoint and dealt with the validity of some existing theories.

The meeting was fairly well attended, with about 100 people registering. (*From a report by E. M. Brooks.*)

Chemistry

No report has been received from the secretary of Section C, Chemistry, but a few brief notes can be prepared from material in the office of the Permanent Secretary. The feature of the meetings of the section was a symposium on chemotherapy, consisting of eight papers which were presented in four sessions on Thursday and Friday, 28–29 March. In order to provide ample opportunity for discussion of the papers, only two speakers were scheduled in each session. R. B. Woodward and S. A. Waksman, in collaboration with A. I. Schatz, were the principal speakers on the Thursday morning program; Walter Seeger and K. P. Link featured on the Thursday afternoon program, which was followed by a business meeting of the section committee and a dinner, at which the retiring chairman of the section, Arthur J. Hill, gave his address. E. A. Doisy acted as honorary chairman of the dinner and introduced the speaker. On Friday, the symposium on chemotherapy was continued, various aspects of biochemistry being presented by E. A. Evans, W. Price, M. Slein, S. P. Colwick, C. F. and G. T. Cori, O. H. Gaebler, and R. J. Williams. The sessions were well attended and well received.

Astronomy

Section D, Astronomy, met for two sessions, first on the afternoon of Friday, 29 March, and again on the forenoon of Saturday. The program included 17 papers.

The retiring vice-president, Seth B. Nicholson, of the Mount Wilson Observatory, addressed the section on "The Solar Cycle." O. C. Mohler presented the retiring address of Robert R. McMath, of the McMath-Hulbert Observatory, which had been postponed from the Dallas meeting. This address, entitled "Three-dimensional Work on Prominences," was illustrated by motion pictures of solar prominences. The vice-president of the section, J. J. Nassau, of the Case School of Applied Science, presented a paper on "Problems Relating to Objective Prism Spectra," and the vice-president elect, G. Van Biesbroeck, of the Yerkes Observatory, presented a paper on "Nebular Photographs With the 82-inch McDonald Reflector."

A paper which attracted considerable interest was "Possibilities in the Astronomical Use of Radar," presented by W. W. Salisbury, of the Collins Radio Corporation. Other papers touched on the subjects of stellar constitution, eclipsing binaries, the recent nova T Coronae Borealis, the orbits of comets, of Mercury, and of Uranus, celestial navigation, and stone-dropping meteors.

The number attending the Friday afternoon session was estimated at 35, and the number attending the Saturday forenoon session was estimated at 40. To give more time for the section luncheon on Saturday, the papers of absent authors were placed at the end of the program, and a few were merely read by title. The section members were entertained at luncheon by Eugene and Jessica Y. Stephens at their home in Clayton. (*From a report by C. C. Wylie.*)

Geology and Geography

Section E, Geology and Geography, held nine sessions on Wednesday, Thursday, and Friday. Most of the sessions consisted of symposia or of integrated papers on related topics. This method of program construction appeared to be successful and met with general approval. Attendance varied from 35 to 90, with an average of 60 at each session. The estimated number of different persons attending all sessions was 325.

The Section Committee met for dinner and discussion of section policies on Thursday evening, with an attendance of 15 committee members and guests who had had a part in arranging the symposia and facilities for the St. Louis meeting. The sessions had the cooperation of the Geological Society of America, the Association of American Geographers, and the American Institute of Mining and Metallurgical Engineers, Industrial Minerals Division; and the specially printed Section E program, with abstracts, was provided through the cooperation of the Geological Society of America. Carl Tolman was chairman of the local committee for the meetings.

On Wednesday, both morning and afternoon, the section held a symposium on Pennsylvanian, organized by H. R. Wanless. The first part was composed of five summary papers dealing with stratigraphic principles and problems of the Appalachian, Mid-continent, Texas, and New Mexico regions. The second part of the symposium was made up of five papers on Pennsylvanian paleontology, in which modern uses of invertebrates, microfossils, plant fossils, and spores were discussed.

On Thursday morning the section met jointly with the Industrial Minerals Division of the American Institute of Mining and Metallurgical Engineers for a series of papers organized by Richard M. Foose. These papers dealt with various industrial minerals of the central part of the United States. On Thursday afternoon Howard A. Meyerhoff, retiring chairman, presented his vice-presidential address, "Geomorphology—The Inexact Science." The remainder of the session was given over to six papers, most of which dealt with new discoveries and new conceptions in Appalachian geomorphology.

On Friday morning the section met for concurrent sessions. The first was a symposium on Pleistocene geology, organized by Leland Horberg, in which eight papers were presented on recent Pleistocene discoveries and current problems in the central states. The second session on Friday morning consisted of five papers on general geological topics. At the Friday afternoon session, six papers on Missouri geology were presented in a session organized through the cooperation of E. D. Clark and E. B. Branson.

On Wednesday afternoon Section E joined with Section K in a joint symposium on "The Impact of Technology on Society," and on Thursday morning with Sections O and K in a symposium on "Relations of Soils to Plant, Animal, and Human Nutrition." [See reports of Sections O and K.] (*From a report by G. W. White.*)

Zoology

The formal programs of Section F, Zoology, were held under the sponsorship of the American Society of Zoologists.

At the business meeting of Section F it was resolved that after 1 January 1948 the Executive Committee of the Section Committee should consist of the elected secretaries of the following affiliated societies: Entomological Society of America, American Society of Zoologists, American Association of Economic Entomologists, American Society of Naturalists, Ecological Society of America, Genetics Society of America, American Microscopic Society, Limnological Society of America, and American Society of Parasitology.

The chairman and secretary of Section F continue as ex officio members of the Executive Committee. It was further resolved that the members elected to the Committee should take office 1 January 1947 and should serve one year only and that the other members whose terms extend beyond 1 January 1948 should continue to serve their term.

The greatest interest aroused in the section was the definite formulation of plans to organize an American Institute of Biology. (*From a report by J. W. Buchanan.*)

At the 20th annual meeting of the American Society of Parasitologists 69 papers were presented either in person, by demonstration, or by title. The address of the retiring president, A. C. Chandler, "The Making of a Parasitologist," was delivered at the end of the morning session of the second day. This event was followed by the annual luncheon and the general business meeting of the Society. The afternoon of the second day was devoted to a demonstration program and a hospitality session. All the program sessions were well attended. One hundred and twenty-one persons were present for the luncheon and business meeting.

At the business meeting, the following persons were elected to the Society offices: president for 1946, N. R. Stoll, Rockefeller Institute, Princeton, New Jersey; vice-president for 1946, H. Kirby, Jr., University of California; secretary for 1946–1947, J. T. Culbertson, Columbia University; and councilors-at-large through 1949, W. T. M. Cameron, of McGill University, and W. H. Wright, of National Institute of Health.

The Society formally endorsed the formation of an organization of biologists on the basis of the two following propositions submitted by the representative to the Council of the Union of American Biological Societies: (1) to provide a means for executing our public responsibilities as biologists and scientists, so that the freedom essential to the progress of science and public welfare be ensured; (2) to safeguard the professional interests of biologists and to assist in providing the material means for the promotion of biological research; also to provide such services as may be necessary to facilitate this program. (*From a report by J. T. Culbertson.*)

The 42nd annual meeting of the American Society of Zoologists was held on 28–30 March in conjunction with Section F, AAAS, and in association with several other biological societies.

One symposium was arranged by President A. S. Pearse with the cooperation of Thomas Park. This dealt with a review of the problem of dynamics of production in aquatic populations. The participants presented a critical review of recent work with respect to certain marine and fresh-water populations. A feature of particular interest was the discussion period which followed the formal presentation of papers.

Although the number of papers read in person was not as large as in the years immediately preceding the war, the number compared favorably with those presented at meetings in the early 1930's. In all, 80 papers were read, and there were also 16 demonstration papers and 105 papers presented by title.

Six regular sessions for the reading of papers were held, in addition to the symposium and a single afternoon demonstration session.

Approximately 350 persons attended the regular sessions of the Society. The annual dinner was held on Friday evening with 280 persons attending. Carl G. Hartman, retiring chairman of Section F, gave the dinner address on "The Little Researcher."

At the annual business meeting, held on Friday, 29 March, the following officers were elected for the year 1946: D. E. Minnich, University of Minnesota, president; E. G. Butler, Princeton University, vice-president; L. V. Domm, University of Chicago, secretary; and A. S. Pearse, Duke University, member of the Executive Committee. (*From a report by L. V. Domm.*)

At a joint meeting of the North Central States Branch of the American Association of Economic Entomologists and the Entomological Society of America, 27–29 March, the entomologists discussed in some detail their relationship with the National Science Foundation. A committee was appointed to prepare a resolution for the support of legislation now pending in Congress. A resolution was later adopted and forwarded to the proper authorities.

The recent developments in machinery for the application of insecticides and fungicides were reviewed by the conference. Particular attention was devoted to the airplane as a modern means of the large-scale application of chemicals to field and forest areas.

The use of DDT in agriculture for the control of many kinds of insects entered into all of the entomological programs. P. N. Annand, chief of the Bureau of Entomology and Plant Quarantine, Washington, D. C., presented a most excellent summary of DDT as it may now be applied against insects attacking agricultural crops. A series of half-day conferences were held on the control of insects attacking field, garden, fruit, livestock, greenhouse, and forest crops. The chemistry and toxicology of the several new chemicals applied against insects were reviewed. A total of 187 entomologists registered for the conference. (*From a report by M. D. Farrar.*)

The 40th annual meeting of the Entomological Society of America was held at the same time as the meetings of the North Central States Branch of the AAEE. About 200 entomologists from the two societies were in attendance. The program included three sessions at which papers were presented, covering a wide scope of entomological research. A joint session was held Thursday morning with the North Central States Branch, at which several important matters of national character, bearing on entomology, were discussed. Friday morning the Entomological Society had a very interesting joint session with the Ecological Society of America. The entomologists' banquet was held on Thursday evening. After the banquet James A. G. Rehn, president of the Entomological Society, gave the presidential address, "Entomology as an Integrant Part of Zoölogical Science."

The business meeting was held Thursday afternoon. Officers for the coming year are: president, C. F. W. Muesebeck; 1st vice-president, S. A. Graham; 2nd vice-president, Alvah Peterson; and secretary-treasurer, Herbert H. Ross.

A high light of the meeting was the participation of a large group of entomologists until recently in the armed services. Many had been discharged only in the last two or three months, and many contributed interesting papers based on their experiences in various parts of the world with unusual aspects of medical entomology. (*From a report by H. H. Ross.*)

Botany

Section G, Botanical Sciences, met in joint session with the Botanical Society of America, the American Phytopathological Society, the American Society of Plant Physiologists, the American Society of Plant Taxonomists, the Mycological Society of America, and the Sullivant Moss Society. The program consisted of the retiring address of the chairman of the section and president of the Mycological Society of America, Frank D. Kern, on "Some Bases for Mycological Progress." This address was followed by a paper by John T. Buchholz, vice-president for the section for 1942, on "Evolutionary Role of Embryonic Selection in Pines," and by an invitation address by E. B. Babcock on "New Light on Evolution From Research on the Genus *Crepis*." The total attendance was about 250. (*From a report by G. W. Martin.*)

The 37th annual meeting of the American Phytopathological Society held in St. Louis on 27–30 March was attended by approximately 325 members. Eighty-three papers on original research on plant diseases were presented in nine sectional meetings. Eleven papers were presented on fungicides; 10 on small grain diseases; 13 on virus diseases; 10 on vegetable diseases; 9 on physiology of pathogenic fungi; 10 on cereal diseases and pathogens; 9 on factors affecting disease resistance; 5 on forest pathology; and 6 on disease resistance and genetics. Three papers were presented in the joint session with the American Mycological Society and the American Botanical Society. Joint meetings also were held with the Potato Association of America and with Section G.

The following conferences were held: Plant Disease Survey, in which the question, "How Can We Improve Our Crop Disease Service?", was discussed; Fungicides, where newer chemical pesticides were considered; Extension; Late Blight of Potato; and Tobacco Research Council.

The annual dinner, held on Thursday evening, was attended by 220 members and guests. The officers for 1946, announced at the annual dinner, are: president, J. H. Craigie; vice-president, A. J. Riker; secretary, E. M. Johnson; treasurer and business manager of *Phytopathology,* R. M. Caldwell; editor-in-chief *Phytopathology,* Helen Hart; councilors, C. H. Arndt, R. W. Goss, R. J. Haskell, H. B. Humphrey, L. D. Leach, M. C. Richards, and C. M. Tucker. (*From a report by E. M. Johnson.*)

The American Society of Plant Physiologists, under the presidency of Paul J. Kramer, Duke University, held six joint sessions with the Physiological Section of the Botanical Society of America; met with Section G on Thursday afternoon; and met with the Physiological Section of the American Society for Horticultural Science and Section O, AAAS, for a symposium on "Mineral Nutrition of Plants and Animals" on Friday afternoon. Attendance was high, averaging 50–75 persons at the six general sessions and 300–400 at the Friday afternoon symposium. A total of 82 papers was presented, with groups of papers or entire sessions on photosynthesis and plant pigments, hormones as growth factors or as herbicides, mineral nutrition, methods, correlation, reproduction, and respiration.

The plant physiologists' dinner was held Friday evening at the Mark Twain Hotel. The election of Dennis Robert Hoagland, University of California, as Charles Reid Barnes Life Member was announced. B. S. Meyer, of Ohio State University, gave the presidential address for 1944, speaking on "The Case for Greater Cooperation Among Science Societies." H. A. Spoehr, Carnegie Institution, retiring president, discussed "The Coming of Age of the American Society of Plant Physiologists," in recognition of the 21st anniversary of the founding of the Society. (*From a report by W. E. Loomis.*)

The Systematic Section of the Botanical Society of America and the American Society of Plant Taxonomists on Thursday and Friday mornings held joint meetings, at which were given a total of 18 papers covering a wide range of topics, most of them illustrated with lantern slides. On Thursday afternoon these two groups met jointly with Section G, AAAS. A memorable occasion was the Friday evening dinner sponsored by the Plant Taxonomists, but attended equally well by members of the Systematic Section. At this dinner Francis W. Pennell delivered the principal address. Saturday morning was reserved for a joint session with the Paleobotanical Section. This session was a symposium, on the general theme "Paleobotanical Taxonomy." The attendance at all of the meetings was very satisfactory, running mostly from 40 to 60. (*From a report by E. E. Sherff.*)

The Botanical Society of America, Inc., held its annual meeting in conjunction with the AAAS and its affiliated societies at St. Louis, 27–30 March, with approximately 560 of its members present. In addition to the daily programs of invitation papers, contributed papers, and symposia presented by the four sections of the Society, joint meetings were held with the American Society of Plant Physiologists, Mycological Society of America, American Society of Plant Taxonomists, Ecological Society of America, American Society for Horticultural Science, and the American Society of Naturalists. The Society also joined the other plant science societies in a joint meeting of Section G on Thursday afternoon. The Southeastern Section of the Society held its annual luncheon on Thursday noon, and the Botanists' Dinner was held on Thursday evening with 367 members present.

A new section of the Society, the Microbiological Section, was organized on Friday afternoon, after which a program of papers on microbiology was presented.

The following officers of the Society were elected and appointed for 1946: Neil E. Stevens, University of Illinois, president; Walter F. Loehwing, State University of Iowa, vice-president; John S. Karling, Columbia University, secretary; George S. Avery, Jr., Brooklyn Botanic Garden, treasurer; Bernard S. Meyer, Ohio State University, editor-in-chief, *American Journal of Botany*; and John T. Buchholz, University of Illinois, member of the editorial board. (*From a report by J. S. Karling.*)

The Mycological Society of America held its 12th annual meeting in St. Louis. The following panel of officers was installed: George B. Cummins, president; John A. Stevenson, vice-president; F. K. Sparrow, secretary-treasurer; Julian H. Miller, George W. Martin, S. M. Zeller, and Frank D. Kern, councilors.

Edith K. Cash and S. M. Pady were appointed to the editorial board of *Mycologia.*

A business session was held Thursday morning, after which there was a program largely concerned with the higher fungi.

The presidential address by the retiring president, F. D. Kern, entitled "Some Bases for Mycological Progress," was also given as the address of retiring vice-president for Section G.

Friday morning's program was concerned with papers on antibiotic substances, fungi parasitic on man, cytology, and Phycomycetes. The afternoon session was devoted to fungi and the war. Papers on textile deterioration, soil burial tests, and fungus damage to battleship equipment were given. In the evening the Society was entertained by Anheuser-Busch, Inc., at a buffet supper, after which papers were heard on the breeding of yeasts and on industrial fermentation with the filamentous fungi.

Saturday morning's session was a joint one with the American Phytopathological Society and Botanical Society. Papers were given on disease-producing fungi, cytology, inheritance of pathogenicity, and nutrient and cultural requirements of parasitic fungi. (*From a report by F. K. Sparrow.*)

The American Microscopical Society held its Executive Committee meeting Thursday noon. There was a large representation of the entire executive group, which included five past presidents of the Society. Among the subjects discussed were means of meeting the increased costs of publication of the *Transactions* due to increased rates and the return to normal volume. Slight increases in subscription rates and membership dues were agreed upon, as was also the establishment of sustaining and institutional memberships. Favorable responses were given to support of a national Scientific Research Foundation and to the organization of an Institute of Biology.

The annual meeting, held on 29 March, was called to order by the president, Raymond C. Osburn. Favorable reports from the treasurer, A. M. Chickering, and from the acting custodian of the Spencer-Tolles Endowment Fund, Lyell J. Thomas, were received. A necrology of seven members was announced. Six of the deceased members had held membership for more than 55 years. The list included Edward Bausch, a member since 1879; Simon H. Gage, 1882; William Bausch, 1888; Edward Pennock, 1879; Frank Patrick, 1891; William Carl Gower, 1939; and Henry B. Ward, 1887.

Various items recommended by the Executive Committee were adopted by the Society, which voted to meet with the AAAS in Boston next December. Officers elected for 1946 were: president, J. E. Ackert; first vice-president, William Procter; second vice-president, O. W. Richard; secretary, F. E. Eggleton; acting custodian of the Spencer-Tolles Fund, L. J. Thomas; member of the Spencer-Tolles Committee, L. E. Noland; and elective member of the Executive Committee, R. C. Osburn. (*From a report by J. E. Ackert.*)

The American Society of Naturalists sponsored the annual Biologists' Smoker, which was held in the Grand Lounge, Municipal Auditorium, on Thursday evening, 28 March, at 9:00 P.M. An estimated 1,000 persons were in attendance. On Saturday afternoon, 30 March, the annual symposium was held on "Recent Advances in the Dynamics of Behavior." The following addresses were scheduled: "Functional Plan of Organization of the Nervous System," R. Lorente de Nó; "Chemical Kinetics in Relation to Aspects of Behavior," Hudson Hoagland; "Biology of Drives," Curt P. Richter; and "Modern Dynamic Psychology," Carney Landis. The symposium, which was attended by approximately 300 persons, was arranged by Karl S. Lashley. Following the symposium, the retiring president of the Society, E. W. Sinnott, delivered his presidential address on "Substance or System, the Riddle of Morphogenesis." The annual Naturalists' Dinner was omitted this year. At the annual business meeting, C. W. Metz was elected president, and H. A. Spoehr, vice-president. (*From a report by R. E. Cleland.*)

The Beta Beta Beta Biological Fraternity held its regular meeting following a luncheon at the DeSoto Hotel on Thursday. The feature of its program was an address by Wyman R. Green on the life and work of Clarence E. McClung, who was president of Beta Beta Beta at the time of his death. In the business session following the program, plans were made for continuing various phases of activity sponsored by the general society: publication of *Bios*; the undergraduate competition in thesis writing; the McClung Award for undergraduate research; publication of the classroom and vocational guidance series of *Booklets*; and the holding of regional conferences.

New chapters were granted to petitioning groups at Drake University, Texas State College for Women, and Huntingdon College. Officers elected for the ensuing biennium were: Lloyd M. Bertholf, president; F. G. Brooks, secretary-treasurer; Earl Bowen, P. H. Yancey, H. J. Eigenbrodt, A. V. Hunninan, and E. R. Noble, regional vice-presidents. (*From a report by F. G. Brooks.*)

The Ecological Society of America held its 30th annual meeting from Wednesday to Saturday. There were nine sessions, at which 68 speakers presented papers. Total attendance was about 150.

On Thursday afternoon there was a joint symposium with the American Society of Zoologists and the Limnological Society of America on "Aquatic Populations." This event included the following speakers: Thomas Park, University of Chicago; George L. Clarke, Harvard University and Woods Hole Oceanographic Institution; Robert W. Pennak, University of Colorado; W. T. Edmondson, Woods Hole Oceanographic Institution; and W. E. Ricker, Indiana University.

Joint sessions were held with the Entomological Society of America and the Botanical Society of America. Highlights of the strictly intrasociety sessions were the one on applied ecology, John M. Aikman, Iowa State College, chairman; and that on the teaching clinic, Paul B. Sears, Oberlin College, chairman. A very satisfactory ecologists' dinner was held on Friday evening, followed by an illustrated address by the past president, Robert F. Griggs, George Washington University, entitled: "Timberlines of North America."

Officers for 1946 are: John M. Aikman, Iowa State College, president; Aldo Leopold, University of Wisconsin, vice-president; William A. Dreyer, University of Cincinnati, secretary; and Henry J. Oosting, Duke University, treasurer. (*From a report by W. A. Dreyer.*)

The Genetics Society of America held its meetings on 28–30 March. Demonstration papers were presented at Washington University on the morning of 28 March, with 19 investigators demonstrating either living material or prepared slides and specimens.

The annual luncheon and business meeting was held in Macmillan Hall on the campus at noon, with 141 members present. In the absence of the other officers, the secretary presided. Since the journal *Genetics* no longer needs financial support from the Society, the dues for 1947 were reduced to $1.50. Members are urged, however, to subscribe to *Genetics*. A report was presented by Dr. Muller on the aid of geneticists in wartorn countries. Dr. Metz spoke in support of the Institute of Biology to be formed during the meetings, and a motion for support was carried unanimously. Dr. Demerec reported that the next International Genetics Congress would probably be held in Denmark and Sweden in 1948.

The remainder of the meetings were held in Hotel Lennox. On Thursday and Friday afternoons a total of 25 short papers was presented. Friday morning the Society held a joint session with the American Statistical Association, at which time a symposium was presented on "Statistical Analysis of Hybrid Vigor." On Saturday morning five invitational papers were presented on various timely phases of genetic research. Saturday afternoon was given over to a joint session with the American Society of Naturalists, where a symposium on "Neurodynamics of Behavior" was presented.

The average attendance at the sessions of the Society was about 150. (*From a report by L. H. Snyder.*)

At the eighth annual meeting of the Limnological Society of America Paul S. Welch, of the University of Michigan, was elected president. Prof. Welch has served the Society as secretary-treasurer since its founding in 1935. A. D. Hasler, of the University of Wisconsin, succeeded A. H. Wiebe, of the Tennessee Valley Authority, as vice-president. G. L. Clarke, of Harvard University and the Woods Hole Oceanographic Institution, the retiring president, was elected secretary-treasurer.

The first session of the eighth annual meeting of the Society was held jointly with the American Society of Zoologists and the Ecological Society of America on Thursday afternoon, 28 March. The meeting consisted of a symposium on the "Dynamics of Production in Aquatic Populations." The meeting of the Society was continued on Friday with morning and afternoon sessions, at which 15 papers were presented. Between 50 and 100 members of the Society attended these sessions and remained for the business meeting which followed the afternoon session. (*From a report by G. L. Clarke.*)

The National Association of Biology Teachers, meeting with the AAAS in St. Louis, had an excellent experience as an organization. Members took advantage of the many other biological meetings, made new contacts, attended important sessions of ecology, embryology, genetics, physiology, parasitology, pathology, and others.

The NABT conducted its meetings Friday and Saturday, 29–30 March, at the DeSoto Hotel. Under the leadership of its president, Prevo L. Whitaker, Indiana University, Friday was devoted to the business session.

The program on Saturday was in charge of E. Lawrence Palmer, Cornell University, and the sessions were concluded Saturday evening by a banquet attended by 121 members and guests. The speaker was Otis W. Caldwell, general secretary, AAAS, who discussed the subject: "Of What Does Good Biology Teaching Consist?" (*From a report by H. P. K. Agersborg.*)

On the evening of 28 March, at St. Louis, about 150 biologists attended an open meeting sponsored jointly by the Union of American Biological Societies, the American Biological Society, and the American Society of Naturalists, to consider the establishment of an Institute of Biology to represent and support the interests of American biologists. Robert Chambers, president of the Union of American Biological Societies, presided. The principal speaker was Detlev Bronk. Dr. Bronk pointed out the numerous advantages which biologists would gain by having an Institute, and then outlined some tentative plans for such an organization based largely upon the results of an informal meeting of a few biologists of Cleveland, Ohio, in September 1944. Following some general discussion of Dr. Bronk's address, it was unanimously voted to have the original Cleveland group form the nucleus of a committee authorized to proceed with the development of an American Institute of Biology. This committee was authorized to invite to work with it any other sincerely interested biologists who cared to contribute the necessary time and energy. The original informal Cleveland committee consisted of the following: Detlev Bronk, University of Pennsylvania, chairman; F. A. Brown, Jr., Northwestern University, secretary; E. G. Butler, Princeton University; Robert Chambers, New York University; A. J. Carlson, University of Chicago; R. E. Cleland, University of Indiana; B. M. Duggar, University of Wisconsin; R. C. Smith, Kansas State College; H. B. Steinbach, Washington University; C. V. Taylor, Stanford University; and Paul Weiss, University of Chicago.

The Society for the Study of Evolution was formally organized in St. Louis on 30 March 1946. The newly elected officers are: George G. Simpson, president; E. B. Babcock, J. T. Patterson, and A. E. Emerson, vice-presidents; Ernst Mayr, secretary; K. P. Schmidt, treasurer; E. R. Dunn, H. J. Muller, Sewall Wright, G. Jepsen, Th. Dobzhansky, and R. Chaney, members of the Council. The Society is an outgrowth of the Society for the Study of Speciation and of the National Research Committee on Common Problems of Genetics, Paleontology, and Systematics. The Society is open to all individuals interested in the dynamics of evolution. Attendance at the organization meeting was about 70 persons. Dues for 1946 were set at $1.00. Contributions for the establishment of a journal will be welcome. It is planned to hold the next meeting with the AAAS in Boston after Christmas 1946. Communications should be addressed to Ernst Mayr, Secretary, American Museum of Natural History, Central Park West at 79th Street, New York 24, New York. (*From a report by A. E. Emerson.*)

Psychology

Section I, Psychology, met jointly with the Midwestern Psychological Association on Thursday, Friday, and Saturday. Although there was no separate registration of the Midwestern group, it was estimated that approximately 200 members attended the sessions. Fifty new members were elected, making a total roster of some 550 people. This was the first meeting of the Midwestern Psychological Association since 1942. Altogether 43 papers were read. Sessions dealt with general psychology, abnormal psychology, comparative psychology, social psychology, and child psychology.

At a joint session of Sections I and Q and the Midwestern Psychological Association, the vice-presidential addresses for those three organizations were given. The speakers were Sidney L. Pressey for the Midwestern Psychological Association, who spoke on "Acceleration: Disgrace or Challenge?"; Florence L. Goodenough, the retiring vice-president of Section I, who spoke on "Semantic Choice and Personality Structure"; while H. H. Remmers, retiring vice-president of Section Q, spoke on "You *Can* Change Human Nature."

The Midwestern Psychological Association announced that its new officers are: Dael Wolfle, president; Claude Buxton, secretary-treasurer; and Fred McKinney, council member. Sidney L. Pressey, the retiring president of the Midwestern Psychological Association, was elected vice-president of the AAAS and chairman of Section I. (*From a report by Harold E. Burtt.*)

The Society for Research in Child Development, in addition to the regular meeting, held informal meetings of officers on Thursday evening, 28 March, and at a luncheon on Friday, 29 March. The Governing Council approved a list of applications for membership in the Society, discussed the advisability of holding a general meeting in the near future, considered necessary business, and laid plans for the agenda of the business meeting.

The first session of the general meeting on 29 March included reports of current research at Antioch College, the University of Illinois, the University of Iowa, and the University of Minnesota.

The second session was a round-table discussion of plans and policies in the postwar world. The main topics discussed were: (1) the problems of obtaining funds and of securing trained personnel to carry on research in child development; (2) the possibility of the Society for Research in Child Development and the Committee on Child Development of the National Research Council forming a nucleus to coordinate research in the child field, or (3) a revolving coordinating committee of experts from the Society to take on the project; (4) the appointment of an outstanding person to carry out and direct a planned project; and (5) the question of individual *vs.* group research, etc.

The third and final session was the business meeting of the Society. In addition to regular business, the following major items were approved: (1) change in election procedure; (2) change of name of the head of the Society for Research in Child Development from chairman to president, this change being made in order to conform to the policy of other societies; and (3) the publication of a popular book for parents.

There was great enthusiasm for future work in child development, and an interest by members and nonmembers alike in the work of the Committee on Child Development and the Society for Research in Child Development. The feeling was general and genuine that it was advantageous to meet with the AAAS for the reason that it was possible to attend sessions of the Association of interest to an interdisciplinary group such as the Society for Research in Child Development. Formal resolutions were prepared expressing thanks to the Association for the excellent arrangements made for hotel accommodations and for the meeting. (*From a report by Beulah Brewer.*)

Social and Economic Sciences

Section K, in partial cooperation with Pi Gamma Mu and Section E, held six program meetings built around the central theme, "The Impact of Technology on Society." In cooperation with the American Library Association, it sponsored an exhibit of books, "The Social Impact of Science," representing holdings of St. Louis libraries and based upon a bibliography prepared by the Library of Congress for the Kilgore Committee.

Programs covered the fields of Planning, Economic Organization, International Relations, Regional Study, Religion, and Human Conservation. A portion of the papers are to be published in *Social Science,* official organ of Pi Gamma Mu, the National Social Science Honor Society.

A business session was devoted to discussion of the function of Section K in relation to other sections of the AAAS and to various national social science organizations. It was decided that Section K should serve as a liaison agent to correlate the interests of such groups.

The papers and discussions emphasized several important relationships between the social sciences and technological change: (1) Technological change is both a result and a cause of social change. (2) It is possible to predict and to plan for technological change. (3) Social research and planning are needed to add meaning to scientific progress in terms of human values. (*From a report by Paul Howard.*)

For the first time in over 25 years of association with the AAAS as an affiliated society, the American Statistical Association and its Biometrics Section arranged a major program for the AAAS meeting. This program consisted of seven sessions. Three of the sessions were symposia of a rather general character, while four dealt with applications of statistical methods to various agricultural and biological problems.

The first of the general symposia was on "Quality Control in American Industry," in which the development of industrial quality control during recent years was discussed. Participants included: F. J. Halton, Jr., Deere and Company, chairman; A. I. Peterson, Radio Corporation of America; J. S. Tawresey, Bunting Bronze and Brass Company; Cdr. E. W. Cannon, Navy Bureau of Ships; and B. L. Clark, Merck and Company. The second general symposium was on "Social Sampling and the Measurement of Opinion." This discussion dealt with the rapidly growing field of opinion polls and surveys and their social, political, and economic applications. Among the participants were: W. F. Ogburn, University of Chicago; S. A. Stouffer, Harvard University; and S. S. Wilks, Princeton University. At the third symposium, devoted to "Personnel Selection by Psychological Tests," personnel selection procedures were discussed with special reference to those used in the Army and Navy during the war. Participants included: P. J. Rulon, Harvard University, presiding; Henry Chauncey, College Entrance Examination Board; Col. John C. Flanagan, Army Air Forces; Cdr. E. L. Kelley, Office of Research and Inventions of the Navy; and M. W. Richardson, U. S. Civil Service Commission.

Of the four sessions arranged by the Biometrics Section, one was devoted to statistical problems relating to studies of hybrid vigor and was held jointly with the Genetics Society of America; another consisted of papers on statistical problems in horticultural research and was a joint session with the Horticultural Society; and the other two were concerned with statistical methodology of various experimental designs in agricultural and biological research. Approximately 15 papers were read in these four sessions. Participants in the sessions included: J. W. Gowen, Paul G. Homeyer, and G. W. Snedecor, Iowa State College; R. L. Anderson and J. A. Rigney, North Carolina State College; H. H. Strandskov and G. J. Siemens, University of Chicago; H. C. Fryer and D. C. Warren, Kansas State College; M. E. Muhrer and A. G. Hogen, University of Missouri; W. P. Judkins and Donald Comin, Ohio Experimental Station; Donald F. Jones, Connecticut Agricultural Experiment Station; W. T. Federer, E. L. LeClerg, B. L. Wade, F. M. Wadley, and G. F. Sprague, U. S. Department of Agriculture; and various discussionists.

The attendance at these seven sessions varied from 20 to approximately 150 persons. (*From a report by S. S. Wilks.*)

History and Philosophy of Science

The most significant phase **of the program of Section L, History and Philosophy of Science, was the participation of a representative group of people in the philosophy of science from every section of the United States. A very rich symposium was held on "Theory and Prediction in Science." After a brief formulation of the problem and issues by Rudolf Carnap, the following persons participated in a panel discussion: A. C. Benjamin, Max Black, Philip Frank,**

Carl Hempel, Henry Morgenau, Ernest Nagel, F. S. C. Northrop, Hans Reichenbach, Alfred Tarski, and Norbert Wiener. A symposium was also held on the "Philosophy of Biophysics," under the chairmanship of F. S. C. Northrop, with H. S. Burr, Henry Morgenau, and Raymond Zirkle participating. The discussion was directed to the problem of the relation between the particle physics and the field physics approach to biology. The group in the philosophy of science selected a program committee consisting of F. S. C. Northrop, chairman; Max Black, Rudolf Carnap, Ernest Nagel, Hans Reichenbach, and R. J. Seeger, ex officio. This committee is already planning two symposia for the 1946 Boston meeting: one on the "Philosophy of Mathematics," under the responsibility of Max Black, and the other, under the responsibility of Ernest Nagel, on the question: "How far does scientific method determine the social ends for which scientific discoveries are used?"

Highlights of the history of science program were two symposia. A symposium on "Science and Society" discussed the relation of government to scientific research. Father Patrick Holloran urged the desirability of independent scientific groups, whereas James B. Conant presented the need for cooperative investigations. The other symposium concerned the "History of Antibiosis." The chairman, John F. Fulton, struck the keynote by stressing the roles played by various persons besides Fleming in the development of penicillin as a therapeutic agent. The prehistory of penicillin (1877–1929) was outlined by Jules Brunel. Recent progress in the use of antibiotics in tuberculosis, with special reference to streptomycin, was presented by William H. Feldman and H. Carwin Hinshaw. Plans have been made for a symposium at the Boston meeting on "The Place of the History of Science in General Education." (*From a report by R. J. Seeger.*)

Medical Sciences

Section N held a symposium on "Medical Science and Industry" in the auditorium of Washington University School of Medicine. The project was arranged in cooperation with the Council on Industrial Health of the American Medical Association. All of the participants were outstanding workers in their separate specialties, and the papers were prepared on invitation from the program committee.

On Wednesday morning the theme was "Atomic Energy." J. Kennedy, of Washington University, introduced the subject by a discussion on the disintegration of the atom. This presentation was followed by a consideration of the hazards and benefits of nuclear energy and the problems of health protection attendant on its production and use. In purposefully employing the atomic bomb as an instrument of destruction there are three effects: (1) from blasts, (2) from burns, and (3) from irradiation. The effects from blasts are the most devastating. The hazards of production as regards humans are limited to exposure to sources of neutrons, gamma, beta, or alpha rays, and are readily subject to control. The fourth paper, in a cognate field, was a report on the results of the therapeutic use of P 32. The data are most encouraging when used in the treatment of certain blood diseases and suggest extending this line of investigation to include C 14 and similar compounds.

In the afternoon five papers were read on the subject of trauma. With the advent of compensation laws, the whole subject of the etiological relationships of trauma to disease became of prime importance. Attempts to obtain objective data by animal experimentation have been most unsatisfactory; thus much of our knowledge is based on clinical experience. Following discussions on the relationship of trauma to diseases of the gastrointestinal tract, lungs and pleura, and heart there was a consideration of "Hostile Dependent Behavior in Rehabilitation" and "Compensation in One Trauma Cancer." In summing up the last subject Maj. G. Seelig stated: "I think that we shall eventually occupy a common ground in our reasoning toward the same conclusion that trauma may provoke, evoke, or incite the growth of cancer in a fashion that we do not now understand."

On Thursday, in morning and afternoon sessions, nine investigators contributed to the two themes: "Occupational Restoration and Positive Health in Employment Procedures" and "Industrial Medicine as a Special Discipline and Industrial Toxicology." Robert Elman, of Washington University School of Medicine, a member of the National Research Council wartime committee on convalescence and rehabilitation, pointed out that experience in Army hospitals showed that the traditional surgical practice of telling a patient nothing and not letting him move was unsatisfactory. By careful attention to psychological, physical, and nutritional aspects the apprehension of a patient is alleviated and convalescence speeded. Harold Storms, of the Rehabilitation Clinic of the Ontario Workmen's Compensation Board, Toronto, described the activities of this group in functional rehabilitation. One of the outstanding features of the morning program was a group of three papers on employer-employee relations. Many examples were drawn from experiences during the war in rapidly expanding industries, on the one hand, and the difficulties arising in such newly created cities as the Oak Ridge Project, where secrecy complicated and added to the mental tension of everyday life.

Following two papers on "The Scope of Occupational Health and Medicine" and "The Program of the Council on Industrial Health of the American Medical Association," J. Carlisle, of Rahway, New Jersey, continued the afternoon program with a report on the results of a study on anoxia in the presence of irritant gases. Treatment was with pure oxygen under slight pressure. The procedure seems to be superior to any other therapeutic method now available.

W. J. McConnell closed the symposium with a consideration of the coordination of safety practices with a progressive hygiene program in the protection of workers in 101 Army ordnance plants involving over 300,000 workers in nine industrial groups during World War II. The results were outstanding and, as the war drew to a close, complete protective measures were in effect.

The subject of the address of the chairman of the section, Warfield T. Longcope, professor of medicine, Johns Hopkins University, was: "The Importance of Researches Upon War Gases to Clinical Medicine." This served as a very fitting terminal paper for the symposium. New methods of treating heavy metal poisoning, certain diseases of the blood, and edema of the lungs were developed as a result of this work when it seemed apparent that gas warfare would be unlikely. There was considerable evidence that phosgene gave temporary relief in Hodgkin's disease and that PF3 had value in the treatment of glaucoma.

The program of Section N was in every way a successful one and suggests the continuation of the plan of arranging symposia with invited papers for future meetings. (*From a report by M. H. Soule.*)

Agriculture

In a joint meeting with Section E in the Kiel Auditorium a symposium was held on Soils, Thursday morning. W. A. Albrecht presided. This was the first half of a larger symposium, the theme of which was the relation of soils to plants, animals, and people. This theme was ably introduced by Charles E. Kellogg, chief, U. S. Soil Survey, who showed not only the continuous dependence of the human race upon the soil from the earliest dawn of its existence, but also the influence of soil characteristics on the distribution and movement of the world's human population and on the great civilizations of the past and present.

Pedology, the study of the soil, has grown to the stature of an independent science within the short space of less than a century. That this new science rests upon a solid foundation and has made a permanent place for itself among its older sisters, geology, botany, chemistry, etc., was made clear by Walter P. Kelley, University of California, in his critical analysis of the modern concepts of soil science, and by Frank F. Riecken, Iowa State College, who presented the causes of divergence in the character of soils during their development.

The thousands of widely diverse soil types scattered over the earth have been forced into a relatively few molds—or categories—by Nature's all-powerful forces of climate (mainly temperature and humidity) impinging upon rocks and other soil parent materials for long periods of time. Regional and local modifications have been caused by biological factors, such as type of vegetative cover, by the contour of the land surface, and by other forces. The soil scientist is finding order, not chaos, and clear-cut evolutionary development among soils just as truly as among plants and animals.

That the addition of certain substances to soils would increase crop yields was known more than 2,000 years ago. Progress in the effective use of fertilizers, however, has occurred almost entirely within the past century, and even now in actual practice it is almost wholly empirical. R. H. Bray, University of Illinois, discussed the chemical status of nutrient substances in soils and their mobility or nonmobility as determining factors in the rate and mechanism of uptake by growing plants. Based on this knowledge, methods for quantitative estimation of the critically important forms of the nutrient elements were developed, as well as mathematical equations for translating these results into quantitative fertilizer requirements and predicted increases in crop yields.

J. E. Greaves, Utah State Agricultural College, was unable to be present to discuss factors influencing the composition of wheat and flour and their relation to nutrition.

The session was attended by nearly 100 men and women representing soils, agronomy, chemistry, geology, geography, social sciences, and farm and home advisers.

The American Society for Horticultural Science held its three-day session in St. Louis with 11 sectional meetings and 3 joint meetings, together with 2 evening sessions.

The nature of the discussions and the interest in the various phases of horticulture are shown by the grouping of the papers into general sessions on fruit crops, physiology of vegetables, physiology of fruits, floriculture and ornamental horticulture, fruit storage and processing, chemical weed control, propagation, nut crops, and small fruits.

Joint sessions were held with the Biometrical Section of the American Statistical Association on plot arrangement; with the American Phytopathological

Society on potato diseases; and with Section O, the American Society of Plant Physiologists, and the Physiological Section of the Botanical Society of America on mineral nutrition of plants and animals. Evening round table discussions dealt with teaching methods, extension methods, and maintenance of plant genetic stocks throughout the world for breeding of fruits, vegetables, and ornamentals. An afternoon session was devoted to physiological problems with fruits and vegetables in consumer packages.

As has been the custom of the Society for many years, the banquet and social evening was in charge of the local horticultural group, under the chairmanship of T. J. Talbert, head of the Department of Horticulture, University of Missouri.

Announcement was made of the award of the Leonard H. Vaughan Memorial Award in Horticulture for outstanding horticultural papers published in the *Proceedings of the American Society for Horticultural Science* to Dr. V. T. Stoutemyer, U. S. Plant Introduction Garden, Glenn Dale, Maryland, for his paper on "The Influence of Changes in Molecular Configurations of Several Naphthyl Growth Substances on the Rooting Responses of Cuttings," and to Dr. P. W. Zimmerman and Dr. A. E. Hitchcock, of the Boyce Thompson Institute for Plant Research, for their paper, "Substances Effective for Increasing Fruit Set and Inducing Seedless Tomatoes."

Officers elected for 1946 were: president, G. F. Potter, USDA, Bogalusa, Louisiana; vice-president, J. E. Knott, University of California, Davis; sectional chairmen, A. L. Schrader, University of Maryland, College Park; R. A. McGinty, Clemson Agricultural College, Clemson, South Carolina; and S. L. Emsweller, USDA, Beltsville, Maryland; and secretary-treasurer, H. B. Tukey, Michigan State College, East Lansing, Michigan. (*From a report by H. B. Tukey.*)

President Tussing presided at the business meeting of the Potato Association of America, which was held on 27 March in St. Louis. The report and financial statement of the secretary, W. H. Martin, was read. The present officers of the Association were re-elected.

In discussion of the place and program of the next meeting, the fact was brought out that the certification authorities had been successfully meeting during the war with the International Crop Improvement Association, and that an effort should be made to attract the certification men to the meetings of the Potato Association, or a joint meeting might be arranged with the Crop Improvement Association. The preference of those present was that the next meeting of the Potato Association be held with the International Crop Improvement Association rather than with the AAAS, and that the program should include at least a half day of papers of special interest to the potato certification workers. A program committee, consisting of Marx Koehnke, chairman, H. M. Darling, and F. A. Krantz, was appointed to arrange for the next meeting. (*From a report by John Bushnell.*)

Some 30 members of various scientific and conservation organizations met on 30 March under the chairmanship of C. C. Adams and, after an afternoon of full discussion, adopted a resolution declaring that:

> ". . . it is the sense of this meeting that there should be organized a central service agency for conservation for the purpose of (1) providing its participating organizations with information regarding pending legislative and administrative programs and (2) furnishing such organizations assistance so far as practicable regarding sources of the most competent scientific information available relating to the activities and interests of member organizations."

A proposed amendment that would have added "(3) and to take such action as it sees fit in its own name" was defeated. The meeting elected Howard Zahniser, executive secretary of The Wilderness Society, to be secretary pending a formal organization and instructed Dr. Adams, as chairman, to appoint an Executive Committee to serve with him in arranging for a formal organization, it being declared the sentiment of the meeting that invitations to participate should be extended to as many organizations as the Executive Committee "may deem discreet." The committee so named comprises Dr. Adams as chairman, A. C. Redfield, Charles G. Woodbury, and Mr. Zahniser, and plans for a formal organization are being formulated under the provisional name "American Conservation Service."

On Friday afternoon, 29 March, with Paul J. Kramer presiding, Sections O and K, in joint session with the American Society of Horticultural Science, American Society of Plant Physiologists, and the Physiology Section of the Botanical Society of America, discussed the human and animal nutrition aspects of the Soil-Nutrition Symposium. Attention was focused chiefly on two phases: (a) deficiencies in human and animal nutrition with an attempt to determine the extent to which such deficiencies are traceable to the soil in which the food or feed is grown, and (b) research into the mechanism of metabolic processes.

Wm. A. Albrecht, University of Missouri, in his vice-presidential address sketched the broader phases of the problem and showed that, as soils come into advanced stages of maturity with old-age weathering, they not only decrease in crop-producing capacity but suffer differential losses of different constituents, particularly calcium in excess of potassium, and decreases in nitrogen. The changes cause shifts in botanical population of plants which can be grown toward those of low value in animal nutrition. Similar changes, but of less extent, may occur within a species.

The South and other regions are confronted by major soil mineral deficiencies or by traditional diets which are seriously deficient in essential vitamins and other nutrition factors. T. D. Spies, Hillman Hospital of Birmingham, Alabama, discussed the incidence, physiology, and amelioration of many of these disturbances, using an impressive array of natural color photographs of symptoms in human subjects.

C. F. Huffman, Michigan State College, discussing "Nutritional Deficiencies in Farm Animals in Relation to Soil and Plant Composition," classified the essential mineral elements of the dietary into two groups. Cobalt, phosphorus, iodine, copper, sodium, chlorine, and occasionally calcium may be sufficiently low in the diet because of soil shortages or unavailability to produce nutritional diseases in livestock. Elements in the second group, including potassium, magnesium, manganese, iron, and zinc, are required by animals, but a deficiency of these elements has not been observed in ruminants under farm conditions. The speaker reviewed recent research which gives conflicting evidence as to the relation between fertilizer use and live weight increases of livestock, and which makes evident the need for further controlled research in this field.

The two succeeding papers were concerned with problems of metabolism studies in living cells. Kurt Stern, Brooklyn Polytechnic Institute, and Kurt Salomon, Washington University School of Medicine, joined in a critical study of iron porphyrin proteins in biological oxidations, the role of nonporphyrin iron and of manganese in fermentation, the functions of hemoglobin iron, hemocyanin copper, and zinc in carbonic anhydrase in the transport and exchange of carbon dioxide and oxygen. The role of other catalysts containing heavy metals in special reactions of vital importance was also discussed briefly.

Philip R. White, Institute for Cancer Research, reported on a critical study of techniques for investigating the nutrition of excised tissues. Culture solutions of fully known constitution are used in plant tissue studies. In adapting these methods to animal tissues resort has been made to heterogeneous mixtures of unknown composition, with a resulting limitation on the kinds of investigation which can be pursued. The author makes a plea for intensive research directed toward the production of improved culture solutions in order to broaden the scope and increase the precision of this type of work.

This session was attended by 450 people representing many fields of research, nearly one-third of whom were forced to leave early because of inadequate seating facilities. (*From a report by E. E. DeTurk.*)

Education

Five sessions of Section Q, Education, were held, including a joint meeting Thurday afternoon with Section I and the Midwestern Psychological Association. A thread of continuity ran through the various sessions which, exclusive of the joint session, comprised an aggregate of 19 papers. A deliberate effort was made to limit the number of participants in order to provide ample time for each speaker to develop his topic.

The opening session on Wednesday morning was devoted primarily to the question of the implications of the Armed Services educational program to public education, with special emphasis upon audiovisual aids. The afternoon session similarly dealt with the Armed Services testing program and postwar educational reorientation of veterans. On Thursday the discussion turned away from the war setting and toward the guidance and adjustment of civilians and the training of guidance workers. The final session, Friday morning, was given to a consideration of postwar education, cooperative curriculum ventures, and the creation of teaching efficiency.

Attendance at the programs of Section Q is traditionally small. The St. Louis meetings provided no exception, since at no time were more than 25 persons present. The papers read were of distinctly superior quality and clearly deserved larger audiences. Discussion of some of these ran far overtime, and requests for copies, either as reprints or in mimeographed form, indicated their importance. (*From a report by H. C. Koch.*)

Science in General

The American Nature Study Society, at its two sessions held in St. Louis as a part of the AAAS convention, brought together 10 educators and naturalists to discuss the role of such agencies as high schools, state parks and museums, state education and conservation departments, teachers colleges, park services, audubon societies, and academies of science in the promotion of conservation and nature education.

Some of the recognized problems were: (1) how to help teachers and youth leaders obtain a better understanding of sound conservation objectives and practices; (2) how to inspire and influence more administrators to undertake the establishment of conservation curricula; and (3) to meet the need for better literature to support such conservation and nature programs.

It was evident from the talks and discussions that St. Louis and Missouri are well launched on a broad program of conservation instruction continuing the fine work of Harris in science and nature starting back in the 1870's; that the State of Indiana is rapidly forging ahead with a strong program involving a summer training program and a series of school manuals; that the national and state parks have a wonderful opportunity for adult and junior programs in this field and that they are meeting them; and that such agencies as the National Audubon Society and the Philadelphia Academy of Sciences are setting fine examples of sound nature and conservation teaching through their summer nature camps and courses, year-round field trip and lecture programs, screen tours, and wildlife auto tours. (*From a report by R. L. Weaver.*)

A small group of invited scientists met informally as a Council on Methodology of Science for a preliminary discussion of the problem of whether or not the present structure of science is sufficiently strong to carry the rapidly increasing bulk of scientific production. Reference was made to progressive specialization, industrialization, group research, disparity of progress in different fields, growing student influx, research subsidies, educational policies, publication difficulties, increasing popular appeal of science and public responsiveness of scientists; and the effect of these factors on the standards of scientific performance and the efficiency and yield of scientific production. Agreement was reached on the need for more factual information on the psychological, economic, historical, educational, and methodological foundations of science. Emphasis was placed on a clear definition of the objectives of scientific research and on giving the initiative of the individual scientist the widest scope in working toward those objectives. It was recognized, however, that scientific procedure will have to be adjusted to the changing technological, educational, economic, and sociological frame. A full participation of all practicing scientists in this process of shaping their future course was declared desirable. As one means to this end, the group recommended the holding of a series of AAAS symposia dealing with the various facets of the scientific process (education, financing, publication, administration, publicity, etc.), particularly as they affect the individual scientist.

The members of the conference were: A. F. Blakeslee, D. W. Bronk, K. S. Lashley, H. B. Steinbach, B. H. Willier, Sewall Wright, R. M. Yerkes, and Paul Weiss, chairman. (*From a report by Paul Weiss.*)

Six science and mathematics teachers' groups cooperated in the program developed by several cooperating societies of teachers of science and mathematics in connection with the 1946 St. Louis convention of the AAAS, 27–30 March. These were: the American Nature Study Society, the Central Association of Science and Mathematics Teachers, the Cooperative Committee on Science Teaching of the AAAS, the National Association of Biology Teachers, the National Council of Teachers of Mathematics, and the National Science Teachers Association. In all, 16 programs were held, including two dinner meetings. In addition, numerous business and committee meetings were arranged for presentation of reports and the conduct of business. All of the programs were extremely well attended. The number of science teachers present ranged from 50 to 150. The meetings probably attracted more than 1,000 teachers of science.

The dinner meeting of the NSTA on 29 March was devoted to the general theme, "Unity and Action in Science Education." The group was honored by the attendance of James B. Conant, president of the AAAS, and A. J. Carlson, past president of the AAAS. Dr. Carlson also was the chief speaker at the Saturday morning meeting, when he presented an inspirational talk on "Science in the High School." All of the science and mathematics teachers joined in the Saturday evening dinner arranged by the National Association of Biology Teachers, at which the chief speaker was Otis W. Caldwell, general secretary of the AAAS. He addressed the group on: "Of What Does Good Biology Teaching Consist?"

The NSTA announced a high mark in its membership, which has reached the total of 2,300 individual members and 18 affiliated science teacher organizations. Among the important reports presented and approved were: (a) report to the Department of State on the status of science courses and teaching apparatus in the United States. This is to be used as a means of helping the devastated countries of the United Nations to re-establish their programs of science education; (b) standards and criteria for free and low-cost materials for science teaching; (c) the place of science in the education of the consumer.

The programs as a whole considered numerous professional problems now faced by science teachers in the elementary schools, in the junior high school, in the secondary schools, and in the colleges. (*From a report by Morris Meister.*)

Sigma Delta Epsilon, Graduate Women's Scientific Fraternity, held its annual convention in St. Louis on 27–29 March. A meeting of the National Council was held on 27 March. On 28 March, Sigma Delta Epsilon sponsored a luncheon for all women in science. Sixty-one scientific women gathered at the Hotel Statler to become better acquainted with each other and to hear Virginia Bartow, of the University of Illinois, speak on "Historical Cooperation Among the Sciences." Matters of national business were considered at a breakfast at 8:00 A.M. on 29 March. Delegates from the 15 chapters of the organization, as well as the National Council members, attended this session. National officers, elected for 1946 are as follows: Nina E. Gray, Illinois State Normal University, Normal, president; Edith Quimby, College of Physicians and Surgeons, Columbia University, New York City, first vice-president; Pearl Claus, University of Wisconsin, Madison, second vice-president; Lela V. Barton, Boyce Thompson Institute for Plant Research, Inc., Yonkers, New York, secretary; and Beulah Armstrong, University of Illinois, Urbana, treasurer.

The fraternity will celebrate its 25th birthday in December 1946 at Boston. (*From a report by Lela V. Barton.*)

The Science Exhibition

Once again the leading supplies of scientific apparatus, equipment, supplies, and books cooperated to present their latest items for inspection by the members attending the AAAS meetings. Nearly all of the exhibitors were able to show new or improved products because of research carried on in conjunction with their activities of supplying the armed forces during the war. In addition to the usual large number of commercial exhibitors there were a limited number of scientific exhibits. The small number of the latter was due to the short time for preparation and the uncertainty of securing approval for releasing war research still covered by security regulations.

The Science Library was one of the most popular exhibits at the meetings. Books were received from nearly 50 different publishers in addition to a score or more of overseas publishing houses. The foreign items came from Canada, England, Russia, Poland, The Netherlands, France, Sweden, Belgium, and Norway.

Through the cooperation of the National Science Teachers Association and the Army Air Forces, two large exhibits on training methods and equipment from Scott Field and the Seventh Defense Command at Omaha, Nebraska, were open for the entire period of the exhibition. The U. S. Public Health Service, the Library of Congress, the Army Medical Library, the National Roster of Scientific and Specialized Personnel, and the Smithsonian Institution were other governmental agencies which provided exhibits.

The exhibition staff of the Washington office has already begun work on the exhibition to be held in conjunction with the December meeting in Boston. A local committee in charge of scientific exhibits is to be appointed, and invitations to participate will be issued shortly.

News and Notes

Capt. R. D. Bennett, technical director, Naval Ordnance Laboratory, spoke on "The Future of Science Under Government" at the meeting of the Philosophical Society of Washington on 16 February.

S. Eilenberg, of the University of Michigan, has been appointed professor of mathematics at Indiana University.

Dr. Herbert E. Longenecker has been appointed dean of the Graduate School at the University of Pittsburgh. Dr. Longenecker, who is dean of research in the natural sciences, succeeds Dr. William T. Root, who died early in 1945. A nutrition authority, he holds many national offices. He is expert consultant on fats and oils for the Office of the Quartermaster General, and a member of the steering committee of the Food and Nutrition Board, National Research Council. He has been a member of its committee on fats since 1942 and chairman since 1943.

Dr. Max E. Chilcote, of the Department of Physiological Chemistry, Loyola University School of Medicine, Chicago, has been appointed Nutrition Foundation Research Fellow in the Department of Agricultural and Biological Chemistry, Pennsylvania State College. Dr. Chilcote will work with Dr. N. B. Guerrant on methods for the estimation of vitamin A and carotene.

Maj. Rafael Rodriguez-Molina, Medical Corps, has been awarded the Army Commendation Ribbon for his service as assistant chief and chief of the Medical Service, 161st General Hospital, A.P.O. 851, U. S. Army.

Dr. Bennett Frank Buie has been appointed professor in the Geology Department at the University of South Carolina, Columbia. Dr. Buie has recently been released from the Army, where he had been serving as a major with the Corps of Engineers attached to the Persian Gulf Command.

Dr. W. A. Shurcliff, scientific and technical adviser to the New York State Department of Commerce, has been given temporary release by Governor Dewey to serve as official historian of "Operation Crossroads," to be carried out in the Marshall Islands this spring by Vice-Admiral Blandy's Joint Task Force One. Dr. Shurcliff was chosen for this new assignment in view of his recent experience in helping edit the "Smyth Report."

Dr. Richard P. Goldthwait, formerly of Brown University and during the war in charge of special equipment investigations for the Army Air Corps at Wright Field, has been appointed associate professor of geology at the Ohio State University.

Philip S. Smith, chief Alaskan geologist of the U. S. Geological Survey, retired from government service on 31 March 1946.

Prof. Franz Knoop has been located and interviewed by a former student of mine. He was in good health at the age of 70, although he had lost 40 pounds. As of 1 April 1946, he retired from his position at the University of Tübingen, and was succeeded by Adolf Butenandt.—*Howard B. Lewis* (University of Michigan).

Dr. Julian B. Rotter, recently separated from the Army, where he was on duty in the AAF Convalescent Hospitals as a clinical psychologist with the rank of first lieutenant, has been appointed assistant professor of psychology at Ohio State University.

Dr. Arthur W. Adamson, former project leader in the research at Oak Ridge, Tennessee, has been appointed assistant professor of chemistry at the University of Southern California.

Dr. James M. Severens, formerly on the faculty of the University of Illinois, is now bacteriologist and director of research and development with the American Scientific Laboratories, Polo, Illinois.

Dr. Horace E. Wood, II, after three years of service as lieutenant and captain in the AAF, has resumed his former position as professor of biology, University of Newark, and research associate in fossil mammals, American Museum of Natural History, New York City.

Prof. David L. Arm, head of the Department of Mechanical Engineering at Iowa State College, has resigned his position to become dean of the School of Engineering at the University of Delaware.

Dr. Harold A. Abramson, assistant professor of physiology at Columbia University, recently addressed the Philadelphia Allergy Society and the staffs of the Pratt Diagnostic Hospital and the New England Medical Center, Boston. In his address, "Aerosol Therapy of the Lungs and Bronchi," Dr. Abramson outlined the general principles of aerosol therapy, described the initiation of the penicillin aerosol therapy program by the Technical Division, Office of the Chief, Chemical Warfare Service, in 1942, and amplified in detail that part of the lung therapy program which was under his direction while he was a member of the staff of the Commanding General, Technical Division, Chemical Warfare Service.

Dr. Clifford S. Garner has been appointed assistant professor of chemistry at the University of California at Los Angeles where he will carry on a program of research in nuclear chemistry. Dr. Garner has been with the Los Alamos Nuclear Bomb Laboratory for the past three years.

Dr. N. Ercoli, formerly with the Research Laboratories of Hoffmann-La Roche in Nutley, New Jersey, has been appointed head of the Laboratory of Pharmacology and Chemotherapy at the Warner Institute for Therapeutic Research, New York City.

Dr. Wayne K. Wilmarth, formerly instructor in chemistry at the University of California, Berkeley, has been appointed assistant professor of chemistry at the University of Southern California.

Dr. E. D. Merrill, director of the Arnold Arboretum, Harvard University, has been appointed as a member of the Advisory Scientific Board of the Gorgas Memorial Institute of Tropical and Preventive Medicine, succeeding the late Dr. Thomas Barbour.

Dr. L. Hissink, Borromeus Clinic, Bandoeng, Java, Dutch East Indies, is confirming his investigations on a plasma substitute, Capain, which he began during the war at the Surgical Clinic of the Medical School in Groningen, Holland. He writes: "The resistance of the (Indonesian) people here is much lower than in Europe. After some bigger operations we often have to treat the postoperative shock." Since not enough blood or plasma is available, intravenous protein hydrolysates are being tried.—*H. Necheles* (Michael Reese Hospital, Chicago).

Dr. Stanley B. Williams, formerly instructor in psychology at Brown University and recently released from active duty in the Navy, has been appointed assistant professor of psychology at Johns Hopkins University.

Dr. Roger G. Barker, formerly of Stanford University, has accepted the G. Stanley Hall chair in genetic psychology at Clark University.

Dr. Waldo Shumway, professor of zoology, University of Illinois, has returned to the University after four years active duty in the Army of the United States. He served as a Colonel in the General Staff Corps and was assigned first to the Special Service

Division and later to the Planning Division of Army Service Forces. He was awarded the Legion of Merit and the Army Commendation Ribbon.

Dr. Wendell R. Garner, formerly special research associate in psychology at Harvard University, has been appointed instructor in psychology at Johns Hopkins University.

R. P. Fischer, formerly research examiner at the University of Illinois, has been appointed full professor of psychology and head of the Department of Psychology at Birmingham-Southern College, Birmingham, Alabama.

Dr. Harry Turney-High, professor of anthropology and sociology and chairman, Department of Economics and Sociology at Montana State University, has returned after more than three years active service with the Army. Dr. Turney-High served overseas for a considerable portion of the period during which he was absent and was a member of the staff of the Provost Marshal.

Dr. Russell B. Stevens has been appointed assistant professor in the Department of Biology at the University of Louisville. He was released from the Army in January after nearly four years in the Medical Department, during which time he saw service in New Guinea and the Philippines.

Dr. Paul L. Risley, formerly associate professor of zoology at the State University of Iowa, is now professor and head of the Department of Biology at the University of Oregon. Prof. H. B. Yocom, former head of the Department, is on leave of absence for the current year. Due to ill health, he has retired from full-time duties.

Dr. Albert Kenrick Fisher, former biologist of the U. S. Biological Survey and since 1931 honorary collaborator in biology of the Smithsonian Institution, celebrated his ninetieth birthday on 21 March 1946. On that evening a group of about 40 of Dr. Fisher's scientific and professional friends gave a dinner in his honor at the Cosmos Club in Washington. "Unfolding the Life of Dr. A. K." was the topic for the after-dinner program. Toastmaster for the occasion was Dr. T. S. Palmer, retired naturalist and one of Dr. Fisher's associates during a good part of his 46 years of government service. Paul H. Oehser, of the Smithsonian Institution, spoke on "Dr. A. K. as We Know Him," and Howard Zahniser, of the Wilderness Society, on "Dr. A. K. as a Naturalist." Others paid high tribute to Dr. Fisher's long and useful service as an economic ornithologist and mammalogist, to his great capacity for friendship and companionship, and to his likable and infectious personality.

Robert B. MacMullin, formerly manager of development of the Mathieson Alkali Works, Inc., announces the opening of a consulting practice in the field of chemical engineering, with temporary offices at 8249 Troy Avenue, Niagara Falls, New York. Mr. MacMullin has just returned from a six-month tour of duty in Germany as technical coordinator for the Foreign Economic Administration and the Department of Commerce.

Dr. M. J. Schiffrin has been appointed research consultant to the Medical Division of Hoffman-La Roche, Inc., after completing 45 months service with the AAF. Previously, Dr. Schiffrin was in the Department of Physiology of Northwestern University Medical School.

Dr. C. C. Speidel, professor of anatomy, University of Virginia, Charlottesville, spoke on "Living Cells in Action as Revealed by Fast-motion Cine-photo Micrography" before the Sigma Xi Chapter of North Carolina State College on 26 March.

Dr. T. G. Yuncker, professor of botany at DePauw University, has been appointed visiting research professor at the University of Illinois for the year 1946–47. He will continue studies on the taxonomy of the Piperaceae, left uncompleted by the late Prof. William Trelease.

Announcements

A School of Forestry has been authorized by the Regents of the University of California. Work in forestry has been carried on previously by a department within the College of Agriculture which has achieved wide recognition for its work. The establishment of the school allows the faculty to operate on a higher administrative level, opens the way to program expansion, and will make possible the organization of a fifth professional year of study leading to a Master's degree in the field. This is the twelfth such school in the United States to offer professional forestry training, according to officials.

Polytechnic Research and Development Company, Inc., successor to P. I. B. Products, Inc., announces the opening of complete facilities for consultation, research, and development in the field of applied physics and microwave electronics at 66 Court Street, Brooklyn 2, New York.

The Louisiana State University Chapter of the Society of Sigma Xi has just established two annual awards for students, a $50 award to the outstanding graduating senior and a $100 award to the most capable Master's candidate. The latter prize was made possible through the generosity of Dr. Lester J. Williams.

The Swedish Board of Education has suggested that English should replace German as the primary foreign language in all secondary schools from the autumn of 1946. This change will take place successively, beginning with the lowest class.

The Board observes that Sweden's relations with the English-speaking world, in the economic as well as in the cultural field, had already strongly developed during the prewar years, while her relations with German-speaking countries showed a decline. Subsequent world events have further contributed to this trend. The interest in Russian and Spanish has likewise increased considerably in Sweden, and the number of pupils studying these languages has multiplied compared with the prewar years.—*Swedish International Press Bureau.*

The American Institute of Nutrition announces that the Mead Johnson and Company Prize for 1945 has been awarded to Dr. Irwin C. Gunsalus, associate professor of bacteriology, Cornell University, and to Dr. Esmond E. Snell, associate professor of biochemistry, University of Wisconsin, for their discoveries and investigations in the field of the B-complex vitamins with special reference to pyridoxal and pyridoxamine.

The Institute also announces the granting of the Borden Award in nutrition to Dr. Philip C. Jeans, professor of pediatrics, College of Medicine, State University of Iowa, and to Dr. Genevieve Stearns, research professor of pediatrics, College of Medicine, State University of Iowa, for their valuable contributions on the nutritive significance of milk and various components of milk in the maintenance of infant and child health.

The Belgian American Educational Foundation, 420 Lexington Avenue, New York 17, New York, has invited 22 Belgian scientists to visit the United States for short study-travel trips during the year, according to Perrin C. Galpin, president. The majority of those invited will arrive before summer. The Fonds National de la Recherche Scientifique of Brussels made the initial selection of 18 men, while 4 were invited directly by the foundation in New York.

The names, principal subjects of study, and Belgian university or other affiliation are: Gerard Baptist, agricultural economics, State Agricultural High School, Ghent; Raymond Bouillenne, botany, Liège; Jean Brachet, biology, Brussels; Raymond Breckpot, chemistry, Louvain; Frederic Bremer, neurology, Brussels; Lucien Brull, internal medicine, Liège; Gaston Dept, history, Ghent; Louis D'Or, chemistry, Liège; Corneille Heymans, physiology, Ghent; Georges Homes, industrial physics, Polytechnic School, Mons; Maurice Houyoux, architecture, Albert I Library; Jean La Barre, pharmacology, Brussels; Michel Legraye, mineralogy, Liège; Jules Lespes, administrative law, Brussels; Gustave Magnel, engineering, tests of materials, Ghent; Joseph Maisin, cancer research, Louvain; Charles Manneback, theoretical physics, Louvain; Paul Martin, surgery, Brussels; Walter Mund, physical chemistry, Louvain; Romaan Ruyssen, chemistry, Ghent; Jan Frans Vanderheijden, library science, Albert I Library; and Victor Van Straelen, paleontology, Royal Museum of Natural History.

All but five of these men have studied in the United States between the two wars. Each visitor will stay a minimum of one month in this country.

The Geology Department of the University of South Carolina has recently acquired the Colburn Mineral Collection. This collection is especially rich in rare and beautiful minerals from the southern Appalachians.

The Sixth Annual Broadcast Engineering Conference met in Columbus, Ohio, during the week of 18 March. The Conference was sponsored by Ohio State University and the University of Illinois, with the cooperation of the National Association of Broadcasters and the Institute of Radio Engineers.

Phi Sigma Society installed a new chapter, Alpha Sigma, at the University of Texas on 2 February 1946. Dr. Efrén C. del Pozo, of the National University of Mexico, and Dr. Robert R. Williams, of the University of Texas, were elected to honorary memberships.

Tests in the United States show that the new British insecticide, sometimes referred to as benzene hexachloride, is not a replacement of DDT and has at present serious shortcomings, Dr. W. H. Tisdale, director of the Du Pont Pest Control Research Laboratory, announced recently. This is the insecticide disclosed in a recent congressional hearing on the 1947 Agricultural Department supply bill. It was said to be seven times more effective against flies than DDT.

"While it shows real promise as an additional lethal weapon against many insect pests," Dr. Tisdale explained, "hexa-chloro-cyclohexane, to use its correct chemical name, will require more research work before it can contribute importantly to the welfare of man. It has a most disagreeable, pungent odor and does not possess the long-lasting toxicity in the field that makes DDT so outstanding."

Du Pont has widely tested hexa-chloro-cyclohexane and distributed samples to state and federal agencies. Experimental reports point to limited use of the insecticide for controlling household, storage, and livestock insects because of the odor. It is more toxic to flies and cockroaches than DDT. In agriculture, tests show it is superior to DDT against such major pests as aphids, grasshoppers, wire worms, and several cotton insects including the boll weevil. However, the Du Pont scientist pointed out, under normal weather conditions where these pests occur in this country, the insecticide is not effective for more than 2 to 4 days. Early reports also show that it is more likely to damage foliage than DDT, especially tender truck crops.

"We will continue to investigate this new product and its possibilities," Dr. Tisdale said, "including the production of a more effective and less odorous form."

Fifty high school chemistry and physics teachers, selected from 10 northeastern states, will be appointed to all-expense General Electric Science Fellowships at Union College this summer, it has been announced by Dr. Carter Davidson, president.

Forty fellowships were made available last summer in the field of physics. This year 50 fellowships will be divided between chemistry, physics, and general science teachers who qualify.

A special course of study, designed to bring the fellows information concerning latest advances in chemistry and physics, will be conducted by the faculty of Union College in cooperation with the scientific staff of the General Electric Company.

The fellowships will cover traveling expenses, living expenses, and tuition at the session which will open 7 July for a six-week term. Graduate credit will be given to qualified applicants.

Formal announcements are being mailed to secondary school principals for transmission to teachers and to individual science teachers in New York, Pennsylvania, New Jersey, Delaware, and the New England states.

The University of British Columbia has announced that the contract has been let for a new physics building, to cost $740,000. Construction will start immediately, and it is expected that the building will be ready for occupancy in January 1947.

The Life Insurance Medical Research Fund, 60 East 42nd Street, New York City, has made grants totaling $126,000 in six university medical schools for research into the causes of cardiovascular diseases.

Recipients of the grants are: Columbia University—Dr. Joseph Victor, Department of Pathology, and Dr. Dickinson W. Richards, Jr., Department of Medicine; University of Minnesota—Dr. Maurice Visscher, Department of Physiology, and Dr. Arthur Kirschbaum, Department of Anatomy; University of Pennsylvania—Dr. H. C. Bazett, Department of Physiology; Southwestern Medical College, Dallas, Texas—Dr. Gladys Fashena, Department of Pediatrics; Washington University, St. Louis—Dr. John R. Smith, Department of Internal Medicine; and Yale University—Dr. John R. Paul, Section of Preventive Medicine.

The University of Hawaii has initiated a project of research in Micronesia to include the biological, physical, and social sciences. A party of four faculty members made a reconnaissance trip to the Marshall, Mariannas, and Caroline Islands from 14 December 1945 to 5 January 1946. The party consisted of Drs. Harold St. John, leader and botanist; John F. Embree, anthropologist; Harvey I. Fisher, zoologist; and Raymond E. Murphy, geographer. The islands visited were: Kwajalien, Ebeye, Majuro, Aur, Arno, Eniwetok, Ponape, Kusaie, Pingelap, Guam, Peleliu, Angaur, and Korror. The trip was made possible through the assistance of the U. S. Navy.

The U. S. Navy Hydrographic Office has recently established a Division of Oceanography which, according to Rear Adm. R. O. Glover, USN, Hydrographer, will provide for increased responsibilities in oceanography recently assigned by the Secretary of the Navy.

Experience during the war has shown that a considerable expansion in knowledge of the oceans is necessary to guide the development of new naval equipment and to aid in strategic and tactical planning. A great increase in fundamental oceanographic research will be required, since present basic oceanographic knowledge has been extended to the limit in its practical application during the war. In addition, new oceanographic techniques have opened many new possibilities of further fundamental investigations.

It is believed that such basic oceanographic research would be of value not only to the Navy but also to many other governmental activities interested in the oceans, their land and air borders, and the organisms living in the sea, as well as to scientific institutions and to various commercial interests. For example, the increase in air travel over water has given increased emphasis to problems of maritime meteorology and air sea rescue, requiring a knowledge of ocean currents. The extension of United States responsibility to regions of the western Pacific has greatly added to the national interest in geophysical and other problems of those areas, of which oceanographic problems are an integral part. Development of new fisheries and conservation of existing fisheries resources may in the future depend more and more on better oceanographic knowledge.

By expanding its oceanographic work, the Hydrographic Office will be continuing its tradition of service to the mariner and will afford other agencies a facility for coordination of oceanographic observations and research. The Hydrographer intends to maintain a central oceanographic library, central files of oceanographic data (to be published in a special bulletin), and a bibliographic service, and to provide charts and manuals utilizing the results of the most recent research. In carrying out this work, the Hydrographic Office will not only make use of the services of its own personnel in the newly established Division of Oceanography, but also will give financial support to oceanographic institutions to permit them to expand their facilities for basic research of interest to the Navy and other governmental agencies. In addition to publications of immediate practical use to mariners, the Hydrographer proposes to publish a series of technical studies which will be of interest to those working in applied oceanography as well as to personnel at research institutions both in the United States and abroad.

To insure an organization most useful to the Government and the maritime interests of the Nation, an Advisory Committee, consisting of representatives of interested activities in the Navy and other government agencies, is being formed to advise the Hydrographer concerning oceanographic problems of special interest to the agencies represented, to assist in coordinating governmental research in oceanography, and to give continuing endorsement to the program. Cooperation of this sort should prove to be a most economical means of furthering the oceanographic interests of the country.

A new tanning compound for sole leather, developed synthetically by chemists, is believed by them to be superior to the natural product formerly obtained from chestnut trees. It is an important development because the natural chestnut material is no longer available domestically, most American chestnuts having been killed by a blight.

This synthetic tannin was developed by chemists of the Monsanto Chemical Company, which claims that it imparts to sole leather a fine, smooth grain as well as desirable qualities of tightness, firmness, pliability, and excellent resistance to abrasion, water, and wear.

The chemical composition of the new tannin is not announced. It is, however, made from domestic raw material, and was developed by examining the complicated molecular structure of natural tannin extracts, and then creating a new product through chemical synthesis. In the development, chemists of the Monsanto Company and the University of Cincinnati leather research laboratory cooperated—*Science Service.*

The National Social Science Honor Society, Pi Gamma Mu, now affiliated (29 March 1946) with the AAAS, gave a luncheon 29 March 1946 at the Claridge Hotel, St. Louis, for the presiding officers and participants in the several sessions of Section K on the "Impact of Technology on Society." Dr. Leroy Allen, national executive secretary of Pi Gamma Mu and professor of religion in Southwestern College, presided, and the national president, Dr. S. Howard Patterson, professor of economics in the University of Pennsylvania, presented his vice-presidential address to Section K on "The Present Challenge to Social Scientists." Dr. John Donaldson, national first vice-president and professor of political economy in the George Washington University, gave an address of welcome. About 40 guests were in attendance.

Immediately after the luncheon, at 2:30 P.M. in an adjoining room at the Hotel Claridge, this year's Pi Gamma Mu Lecture on "Science and Religion" was presented by Dr. Edwin McNeill Poteat, president of the Colgate-Rochester Divinity School. Dr. Patterson presided. (*From a report by Leroy Allen.*)

Six new members have been appointed to the faculty of the Technological Institute of Northwestern University, according to Ovid W. Eshbach, dean of the Institute. Capt. George G. Lamb, recently discharged from the Navy where he coordinated research on aviation fuels, was appointed professor of chemical engineering. Miklos Hetenyi, formerly in charge of the photoelasticity laboratory of the Westinghouse Electric Company, was appointed professor of theoretical and applied mechanics. George Sommerman, who formerly conducted radio research for the Navy under the OSRD, and Alexander Wing, Jr., formerly on the staffs of the pre-radar school and the radio research laboratory at Harvard University, were appointed associate professors of electrical engineering. Robert R. Buss, also of the Harvard radio laboratory, and Lt. John Lyon, recently discharged from the Navy, were appointed assistant professors of electrical engineering.

Five of 16 planned research projects have now been completed by the Hormel Institute in cooperation with the University of Minnesota. These are: "Survey of Literature and Experimental Studies on the Nutritive Value of Soybeans"; "The Nature and Identity of the Natural Preservatives in Animal Fats and the Development of an Analytical Method for Their Measurement"; "Secondary Antioxidants"; "Studies of the Stability of Dehydrated Meats," a war project; and an investigation concerning the use of sulfonamide in treatment of surface wounds, under the sponsorship of Sharpe and Dohme, Inc. Copies of the research projects and a list of papers published or pending may be obtained by writing to The Hormel Institute, Austin, Minnesota.

The Institute was founded in 1942 by agreement between the University of Minnesota and the Hormel Foundation. The Board, made up of five men selected by the University, consists of: Theodore C. Blegen, dean of the Graduate School, University of Minnesota; C. H. Bailey, dean and director, Department of Agriculture, University of Minnesota; R. P. Crane, Board of Trustees, Hormel Foundation; F. C. Mann, professor of experimental surgery, Mayo Foundation; and Walter M. Lauer, professor of organic chemistry, University of Minnesota. The executive director, who supervises all operations of the Institute, is Dr. H. O. Halvorson, professor of bacteriology, University of Minnesota. He is assisted by Dr. Walter O. Lundberg, associate professor of physiological chemistry. All members of the staff from the University retain their faculty status.

At present 5 laboratories are in operation, but the Institute hopes to expand this to 8 or 10 and to increase the range of research as soon as possible.

The Institute for Research in Child Psychology has been reorganized as the Institute for Research in Clinical and Child Psychology. At present, the Advisory Council consists of the following members: Gardner Murphy, chairman; Philip Curoe, Oskar Diethelm, W. H. Gantt, Clark L. Hull, Arthur T. Jersild, Wolfgang Köhler, William S. Langford, H. S. Liddell, Jules Masserman, Dorothea McCarthy, Emil Oberholzer, Frank J. O'Brien, James M. O'Gorman, and Bernard S. Wortis.

Officers elected at the annual meeting are: Livingston Welch, director; Louis Long, treasurer; and Bernard F. Riess, secretary.

A new Department of Biochemistry at Harvard has been established in the Faculty of Arts and Sciences. It will be composed of three subdepartments, Biological Chemistry and Physical Chemistry at the Harvard Medical School in Boston, and a new subdepartment of Biochemistry in Cambridge.

Heretofore, research and graduate instruction in biochemistry have been centered chiefly in the Medical School, primarily because the development of this science in this country has been largely due to its long-recognized importance in the medical curriculum. More recently, an increasing interest in biochemical problems and methods has been displayed by those laboring in the closely allied fields of physics, chemistry, and biology.

The establishment of the new subdepartment in Cambridge will now provide additional facilities for research and instruction in biochemistry in close proximity to the Departments of Biology and Chemistry. It will be staffed by a number of new appointments, and it is expected that certain members of the Departments of Biology and Chemistry, whose interests lie closest to the area of biochemistry, will become part-time members of the new subdepartment. A closer integration of the biochemical interests and needs of all students and faculty members should thus be achieved.

The ever-widening applications of biochemistry, not only to medicine but to agriculture, public health, and to the pharmaceutical, chemical, and food industries, have created a great need for well-trained biochemists to carry on research and teaching in these fields.

Dr. L. J. Havas, formerly of the University of Brussels, Belgium, and at present in Budapest, Hungary, has written to L. Marton, of Stanford University, that he is attempting to write a book on colchicine and its effects and would be grateful to receive all publications on this subject. He appeals to fellow workers in this same field to send him publications on colchicine and related subjects (polyploidizing agents, animal and plant hormones, carcinogenic substances, etc.). He also requests most recent publications on the methods of culture of penicillium and the extraction methods of penicillin. His present address is: Hungarian Agricultural University, Horticultural Faculty, Institute of Special Fruit Growing, Nagyboldogasszony utja 45, Budapest XI, Hungary.

Louisiana State University has announced the establishment of two industrial fellowships in zoology under the direction of Dr. George H. Mickey, associate professor of zoology. The purpose of the research is to study the effects of petroleum refinery wastes upon native fishes of Louisiana streams. A total of $10,550.88 for a three-year period was contributed by six oil companies: Cities Service Refinery, Standard Oil Company, Shell Oil Company, Pan-American Petroleum Corporation, Continental Oil Company, and Chalmette Petroleum Corporation.

The Institute of Statistics, University of North Carolina, announces a statistical summer session to be given at Raleigh from 17 June to 26 July. The science of statistics experienced an exceptionally rapid development during the war. The summer session staff has been chosen for its ability to present the new methods and concepts authoritatively and effectively. Lectures will include descriptions of many recently discovered applications of statistics, as well as both simple and more complex examples of the better known techniques.

The instructional staff consists of: Dr. C. I. Bliss, biometrician, Connecticut Agricultural Experiment Station, and lecturer in biometry at Yale University; Prof. W. G. Cochran, associate director, Institute of

Statistics; Prof. Gertrude Cox, director, Institute of Statistics; Dr. R. A. Fisher, Department of Genetics, University of Cambridge; Prof. G. W. Snedecor, director, Statistical Laboratory, Iowa State College; and Dr. J. Wolfowitz, associate professor, Institute of Statistics.

Eight courses in statistics will be given, including beginning courses in experimental statistics, intermediate and advanced courses in design of experiments, statistical basis of biological assay, sequential analysis, mathematical statistics, and advanced experimental statistics. Further information may be obtained from the Director, Institute of Statistics, North Carolina State College, Raleigh, North Carolina.

The tenth anniversary of the death of Ivan Pavlov, the Russian physiologist who developed the theory of conditioned reflexes, has been celebrated in Moscow by a joint session of the USSR Academy of Sciences, the Academy of Medical Sciences, and the All-Union and Moscow Societies of Physiologists, Biochemists, and Pharmacologists.—*Science Service.*

A Sanitary Engineering and Public Health Research Council of Texas was temporarily organized during the summer of 1945 by representatives of the universities and colleges of Texas interested in research pertaining to sanitary engineering and public health. The objectives of the organization are: to promote research, to facilitate the transfer of information in these fields, and to secure funds for research.

On 7 January 1946, a meeting of the Council was held at the University of Texas, Austin. During this meeting a permanent organization was effected and a program was presented. Annual meetings were planned, with the work of the Council to be carried on by committees for the coming year. Committees appointed included: Committee on Research Resources, with Dean O. V. Adams, of the Texas Technological College, as chairman; Committee on Ways, Means, and Endowments, with Mr. V. M. Ehlers, of the State Health Department, Austin, as chairman; and Committee on Public Information, with Mr. E. E. McAdams, of the Texas League of Municipalities, Austin, as chairman.

Officers of the Council for the coming year are: Dean W. R. Woolrich, of the University of Texas, chairman; Dean O. V. Adams, vice-chairman; Mr. E. E. McAdams, secretary; Dr. J. K. G. Silvey, of North Texas State Teachers College, and Mr. V. M. Ehlers, members of the Executive Committee.

Papers on recent research, presented at the January meeting, dealt with purification of water, algae control, typhus fever control, and a fly-control program. Research projects that might be sponsored by the Council were outlined.

Dr. Stanislas Konopka, director of the Department of Science and Publications of the Ministry of Health in Warsaw, has reported to *Science* on the present status of equipment for medical teaching and research in Poland. His report covers the situation as of the latter part of November 1945 and was forwarded by Dr. Leon Dmochowski, of the Imperial Cancer Research Fund, London.

The war twice fought on Polish territory and the occupation of Poland during the years 1939–1945 brought destruction to every field of cultural and economic life. The cultural losses must be placed first in importance because in the majority of cases the losses are irretrievable, considering the losses of museum collections, archives and libraries. According to provisional estimates, as far as Polish medicine is concerned, Poland has been deprived of 70 per cent of the equipment of scientific institutes, laboratories, clinics and hospitals; in Warsaw the buildings too have been destroyed. Eighty per cent of the medical libraries and museum collections in Warsaw have been destroyed or burnt.

Before the war the main source from which Polish doctors derived their professional and scientific knowledge were the university libraries and the special medical libraries. To the greatest Polish libraries belonged the library of the Warsaw Medical Association, founded in 1820, which contained 67,000 books and medical papers, among them valuable prints from the sixteenth to eighteenth centuries. The second, although much larger library, founded in 1921, was the library of the Military Medical Training Centre. This library was a most active one; it comprised 115,000 volumes, was lending books all over Poland, and possessed a department of bibliography sending on request bibliography from every field of medicine and was publishing Polish medical bibliography. The annual turnover was fifty to sixty thousand books. Besides these two libraries there existed many smaller ones, such as the library of the Chirurgical Society, Gynaecological Society, the Society of Hygiene, etc., and libraries of university clinics and institutes. Of all these libraries only the ruins remain today. In Cracow and in one or two other provincial centres the libraries have been partially saved. In Warsaw, however, only the libraries of the Ophthalmic, Paediatric and Gynaecological clinics have been, to some extent, preserved. Altogether Warsaw lost irretrievably, mainly through fire, twenty-one medical libraries comprising over 550,000 volumes. There is no trace left of the rich museum of the history of medicine. It possessed over 16,000 items, such as old medical instruments, medals, paintings and valuable collections of old medical documents, manuscripts and prints.

During the fighting in Warsaw all the publishing firms and their stocks were lost. This loss is all the more painful, as Warsaw was the main publishing centre of medical and scientific books. Only a few private libraries belonging to medical men remain.

This great dearth of Polish medical books has been increased through the German order published in 1939 forbidding the publication of any Polish books or papers, including all medical books. The Germans, as is well known, also closed all universities.

The Polish medical men and scientists appeal to their colleagues abroad for help in the re-equipment of libraries with books and periodicals. To facilitate and coordinate the help given medical committees for scientific help for Poland have been set up in New York, Moscow, Paris, Stockholm and Zurich. In London the work is centered in the Polish Medical Association.

Plans for major expansion of the University of Rochester's Department of Physics, including additions to the physics building at the River Campus, equipment, and teaching and research staff, were announced recently by President Alan Valentine.

The undertaking will constitute the largest single addition to teaching and research facilities at the University since the College for Men was moved to its new campus in 1930. It is one of the first steps in the 10-year program of postwar expansion, particularly in the College of Arts and Science, made public by President Valentine last fall. Strengthening of the liberal arts and social science fields, chemistry, and engineering departments, with additional buildings to accommodate enlarged personnel and equipment, is included in the long-range program.

The announcement follows closely on the return to the University of Dr. Lee A. DuBridge, professor of physics and chairman of the department, after more than five years leave of absence to serve as director of the NDRC Radiation Laboratory at Massachusetts Institute of Technology.

A nonrecurrent expenditure of $550,000 has been appropriated by the University for an addition to the Bausch and Lomb Building at the River Campus, which houses the Physics Department, and for new equipment. The proportion of the sum to be used for those purposes will be determined after recommendations by Dr. DuBridge. Construction will begin as soon as materials can be obtained.

In addition, the physics budget will be double the department's prewar outlay to permit additions to teaching and research staff, over which Dr. DuBridge also will have supervision.

The Signal Corps Engineering Laboratories have recently organized a Micro Optical Section in the Components and Materials Branch of the Squier Signal Laboratory at Fort Monmouth, New Jersey. The section has been equipped with electron microscope, photographic and direct reading and recording X-ray diffraction apparatus, photographic and direct viewing X-ray radiograph and fluoroscope, grating spectrograph, recording spectrophotometer, interferometer, chemical and petrographic microscopes, apparatus for photomicrography, and other associated equipment for studying the physicochemical properties of Signal Corps materials and components. Major Glenn N. Howatt was officer in charge during the installation of the section, and Dr. V. F. Payne has been civilian chief from its beginning.

Major Howatt went to the Signal Corps from the General Ceramics and Steatite Corporation and has now returned to his former position as chief ceramist. Dr. Payne went to the Signal Corps four years ago from his former position as head of the Chemistry Department of Transylvania College. Dr. B. C. Bradshaw, formerly at Rockefeller Institute, is in charge of electron microscopy and radiology; Dr. Alexander P. de Bretteville, Jr., from the Laboratory of Insulation Research, Massachusetts Institute of Technology, joined the staff to assume charge of the work in X-ray diffraction; Dr. Milton Green, formerly with the Bureau of Standards, is in charge of spectroscopy; Mr. S. Benedict Levin, formerly with the Bureau of Mines, is in charge of optical microscopy; and Miss Pearl Anderson, from Transylvania College, is technical editor.

A grant of $1,200 in support of the research work of Dr. Abraham White has been made to the Mendel Fund of the Department of Physiological Chemistry, Yale University School of Medicine, by the Medical Research Division, Sharp and Dohme.

Farrington Daniels, editorial adviser in chemistry for *Science*, has been honored by having the first nuclear pile for the production of power named after him. Major Gen. L. R. Groves announced 13 April 1946 that the Daniels Pile will be constructed at Oak Ridge, Tennessee. A meeting was held 11 April in New York City to formulate plans for organization; representatives of the Manhattan Engineer District, Army Air Forces, U. S. Navy, Monsanto Chemical Company, General Electric, and Westinghouse were present. Charles Allen Thomas, vice-president and technical director of Monsanto, will be in charge of the project, which is expected to be in operation by early 1947. The design, construction, and operation with auxiliary equipment will cost in the neighborhood of $2,500,000. The plant is regarded as a pilot plant for the production of useful power, and Gen. Groves was careful to state that a considerable amount of work needs to be done "before fissionable material can be brought within the range of economic usability."

A David Anderson-Berry Silver-gilt Medal, together with a sum of money amounting to about 100 pounds, will be awarded in 1947 by the Royal Society of Edinburgh to the person, who, in the opinion of the Council, has recently produced the best work on the therapeutical effect of X-rays on human diseases. Applications for this prize are invited. They may be based on both published and unpublished work and should be accompanied by copies of relevant papers. Applications must be in the hands of the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh 2, by 1 December 1946.

Meetings

The North Carolina Academy of Science will hold its annual meeting on 3–4 May 1946 at the North Carolina State College of Agriculture and Engineering of the University of North Carolina, Raleigh. This will be the first meeting since 1943.

Dr. A. V. Hill, foreign secretary of the Royal Society and recent recipient of the Companion of Honour Award, will represent England at a science and engineering Forum honoring the centennial of the birth of George Westinghouse, according to Gwilym A. Price, president of the Westinghouse Electric Corporation. The Forum will be held in Pittsburgh on 16–18 May.

The opening session, on "Science and Civilization," to be presided over by Dr. Robert E. Koherty, president of the Carnegie Institute of Technology, will include Dr. Isaiah Bowman, president of Johns Hopkins University, and George W. Merck, president of Merck and Company and special consultant to the War Department.

Four aspects of "The Future of Atomic Energy" will be discussed the initial day of the Forum in a group headed by Dr. Karl T. Compton, president of Massachusetts Institute of Technology. The group will delve into the biological, chemical, explosive, and power possibilities of this new form of energy.

A Nobel Prize winner from Columbia University, Dr. I. I. Rabi, will act as chairman at a dinner that evening at which Dr. Vannevar Bush, president of Carnegie Institution, Washington, and director of OSRD, will speak on "Planning in Science."

The following morning will be given over to "Biological Sciences," headed by Dr. Hugh S. Taylor, dean of the Graduate School, Princeton University. Among the participants will be Dr. Selman A. Waksman, professor of microbiology at Rutgers University. Dr. Frank B. Jewett, president of the National Academy of Sciences, will address a luncheon session on "Horizons in Communications."

The Louisiana Academy of Sciences will hold its annual meetings this year on Friday and Saturday, 3 and 4 May, at Centenary College in Shreveport, Louisiana.

Section K is sponsoring, jointly with the Academy of World Economics, Pi Gamma Mu—the National Social Science Honor Society, and the Army Industrial College, a series of meetings to be held in the auditorium of the National Archives, Washington, D. C., 2 and 3 May 1946. The general subject is "Population and Manpower." The three sessions will be: *Thursday,* 2:00 P.M.—"Trends of Population in the United States"; *Friday,* 9:30 A.M.—"Trends of Population in Foreign Areas"; *Friday,* 2:00 P.M.—"Women in War and Industry."

Dr. Benjamin H. Williams, assistant director of research, Army Industrial College, is chairman of the Program Committee composed of representatives of the cooperating organizations.

Elections

Dr. E. G. Butler, chairman of the Department of Biology, Princeton University, was elected president of the Board of Trustees of *Biological Abstracts* at the annual board meeting held in New York on 2 February 1946. Dr. Butler will succeed Dr. A. F. Blakeslee, of Smith College.

At the same meeting Dr. Luther H. Evans, Librarian of Congress, and Dr. J. J. Willaman, Eastern Regional Research Laboratory, U. S. Department of Agriculture, Philadelphia, were elected members of the Board of Trustees.

Other officers of the board elected were: Dr. E. W. Sinnott, Yale University, vice-president; Dr. D. H. Wenrich, University of Pennsylvania, treasurer; Dr. Robert Gaunt, New York University, secretary. Drs. Butler, Sinnott, and C. N. Frey, of the Standard Brands Laboratories, New York, were elected to the Executive Committee of *Biological Abstracts.*

The editorial and business offices of *Biological Abstracts,* now located in the building of the Department of Zoology at the University of Pennsylvania, will be moved during the next summer to a separate building provided by the University of Pennsylvania to permit necessary expansion.

The American Mathematical Society elected the following officers, at a meeting in November 1945, for terms of two years each: L. R. Ford and Saunders MacLane, vice-presidents; W. L. Ayres, R. H. Bruck, and A. C. Schaeffer, associate secretaries. The following were elected members of editorial committees for terms of three years each: Deane Montgomery, *Bulletin*; A. A. Albert, *Transactions*; J. F. Ritt, *Colloquium Publications*; O. E. Neugebauer, *Mathematical Reviews*; A. W. Tucker, *Mathematical Surveys*; L. M. Graves, *American Journal of Mathematics.* New members-at-large of the Council for three-year terms are: R. P. Boas, R. H. Cameron, R. V. Churchill, Churchill

Eisenhart, and A. P. Morse. Prof. M. H. Stone was appointed as a member of the Editorial Committee of *Mathematical Reviews* to fill the unexpired term of J. D. Tamarkin.

The Council voted to hold the summer meeting of the Society at Cornell University, at a date to be decided later.

Recent Deaths

Prof. Amadeus William Grabau died in Peiping on 20 March, according to the Geological Society of America. Prof. Grabau had resided in China since 1920. His last visit to the United States was in 1933, when he was an invited delegate to the Sixteenth International Geological Congress, held in Washington.

Dr. Henry S. Emerson, 38, assistant professor of biology at Amherst College, died suddenly on 8 March.

German Agricultural and Biological Chemists

Dr. Karl Freudenberg, director of the Institute of Chemistry at the University of Heidelberg, was at the University, but his institute was not open. For the past several years he has been working on the chemistry of the lignins. Dr. Richard Kuhn, director of the Kaiser Wilhelm Medical Research Institute at Heidelberg, was working actively with the approval of the American Military Government. Dr. Heinrich Wieland, director of the Institute of Chemistry at the University of Munich, was under house arrest in Starnberg, 15 or 20 miles out of Munich. His home was occupied by the officer in charge of the local American Military Government. Reasons for his house arrest were not clear, but so far as I could learn, he was not under arrest for political reasons.

Dr. Franz Knoop, head of the Institute of Physiological Chemistry at the University of Tubingen, was still active and in charge of his institute, although most of his colleagues were gone. He has been editor of Hoppe-Seyler's *Zeitschrift fur Physiol. Chem.* for many years. The last publications of the journal were issued in late 1944, but he was unable to give me the exact month when publication was suspended, owing to the fact that the French had "liberated" all of his recent volumes, including the unbound volumes of 1944.

Dr. A. Butenandt, of the Kaiser Wilhelm Institute of Biochemistry at Berlin-Dahlem, was working, with several assistants, in Dr. Knoop's laboratory at Tubingen in the French zone. His home in Berlin had been destroyed and his laboratory damaged. However, his colleague, Dr. Hillmans, remained at Berlin-Dahlem and was conducting studies with rats on potential sources of vegetable proteins for human use when I visited him in Berlin.

Prof. Kurt Maiwald, Institute of Plant Nutrition, Prof. Werner Wohlbier, Institute of Animal Nutrition and Agricultural Chemistry, and Prof. George Lakon and others were still working actively on their regular research projects at the Agricultural High School at Hohenheim, near Stuttgart. Some buildings at Hohenheim were destroyed, and most of their microscopes and research instruments had been removed by the French.

Dr. Paul Koenig, director of the State Tobacco Research Station at Forchheim, near Karlsruhe, was endeavoring to carry on his most important research projects without help. Here also all of the laboratory equipment of value had been taken away. His valuable collection of books on tobacco, however, was not lost.

Prof. W. Stepp, director of the Institute of Internal Medicine at the University of Munich, was under house arrest and was being investigated by the American Military Government. His institute and clinic were badly damaged. A new edition of *Die Vitamine und ihre klinische Anwendung,* published with Kuhnan and Schroeder, was published in 1944.

Prof. K. J. Demeter and most of his staff, of the Dairy Research Institute at Weihenstephan, were under arrest for party activities. However, the old Agricultural High School and Experiment Station at Weihenstephan is still staffed by a number of former staff members who are still working on their old projects. Some of these are as follows: Dr. Fritz Reindel (Chemical Institute), Walter Fromel (soils), and W. Schropp (plant nutrition). The school was occupied by about 300 American soldiers who were studying chemistry and agriculture under the general supervision of Maj. Bartley P. Cardon, former biochemist from the University of California. He was using some of the German professors in seminars and special lectures for advanced students.

Dr. Paul Rosbaud, formerly with Julius Springer Publishing House, informed me that Dr. Otto Warburg, head of the Institute of Cell Physiology at Berlin-Dahlem, was in the American zone at the time of my visit but I did not see him. Dr. Rosbaud was under the impression that Dr. Warburg might return to the Russian zone of occupation and continue his research work under Russian supervision, since all of his valuable instruments and equipment had been moved into the Russian zone. His Berlin-Dahlem Institute, which was undamaged, is occupied by the American Military Government.

These facts were obtained by a personal visit late in 1945.—R. *Adams Dutcher* (Pennsylvania State College).

In the Laboratory

Production of Penicillin X in "Submerged" Surface Cultures

EDITH STICE and ROBERTSON PRATT[1]
Division of Microbiological Research, Cutter Laboratories, Berkeley, California

Several references to the potential therapeutic importance of penicillin X have been published (*1, 2, 3, 6*). This compound is of no less interest and importance to plant physiologists and students of mold metabolism than to the clinician, but unfortunately it is not generally available at the present time. The apparatus described below is deemed valuable, since cultures grown in it consistently produce relatively large proportions of this antibiotic agent. The unit was originally devised in an attempt to incorporate in surface cultures the advantages of the deep-vat method of fermentation.

The apparatus is simple in design and may be constructed easily. It will produce a continuous supply of penicillin for several weeks without resterilization or reinoculation. The essential features are shown schematically in Fig. 1 (not drawn to scale).

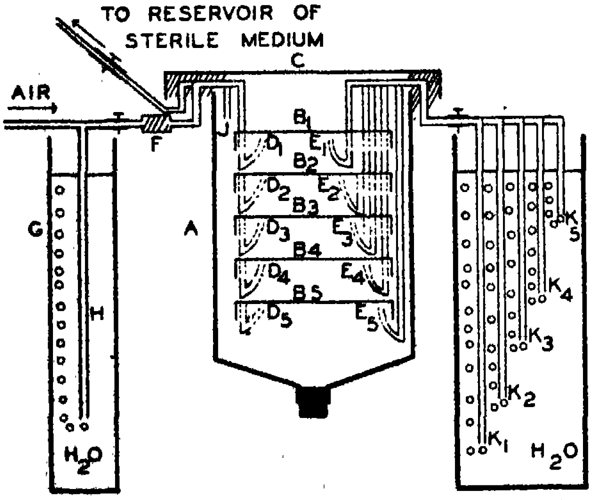


FIG. 1. Schematicized representation of the device for "submerged" surface cultures.

The fermenter, A, may be made any desired capacity, and the rest of the apparatus then may be built accordingly. A convenient laboratory-scale working model has been made from an inverted 10-liter bottle with the bottom removed. Several inverted trays (large Petri dishes or aluminum cake pans have been found practical), B_1, B_2, . . . B_n, are supported by a frame (not shown) consisting of three vertical rods, at the inner periphery of the cylinder, which are attached to a horizontal basal plate anchored by suitable means to the rubber stopper inserted in the mouth of the bottle. Rubber stoppers or sections of heavy rubber tubing slipped around the supporting rods hold the trays in the desired positions. The cover, C, consists of an inverted aluminum cake pan, the inner rim of which is padded with cotton (shown by diagonal lines). Aeration is effected by means of a separate inlet tube, D, and outlet tube, E, for each surface. Tubes and the supporting frame mentioned above may be of glass, stainless steel, aluminum, or Inconel. Incoming air from cylinders or house line passes through the sterile cotton filter, F. The pressure-control device, G, is not essential but is often useful, especially when the pressure on the air line is subject to fluctuation. If the level of tube H is properly adjusted, considerable fluctuation of the pressure of incoming air may occur without causing serious changes in the fermenter and consequent back or forward surging of the fermentation liquor. Samples are withdrawn aseptically from any desired level in the tank by means of a siphon tube (not shown). When not in use for sampling, the exposed end of this tube may be protected by a sterile test tube plugged with cotton. If large quantities are withdrawn, air inlet and outlet tubes should be closed until the initial volume of liquid has been restored by addition of fresh medium. After the mats are well formed, almost all of the solution can be drained from the tank without interfering with subsequent activity of the mold.

In our experiments the dry, sterile fermenter is inoculated by the "dry spore" (*4*) technique with the cover slightly raised at one edge (as for Petri dish inoculation), and then the sterile culture medium is siphoned into it through the J tube, causing the spores to rise and float on the surface of the liquid. During the siphoning operation the air inlet manifold and the outlet tubes, E_1 . . . . E_n, are closed by means of pinch clamps. Consequently, as the liquid rises, an air pocket forms under each plate, providing a surface upon which the mold mat develops. After the fermenter is charged with culture medium, the open ends of the leveling tubes, K_1 . . . . K_n (connected by rubber tubing to E_1 . . . . E_n, respectively), are submerged in water to a depth greater than that necessary to hold the medium under each plate in the fermenter at the desired level, and the tubes are clamped in place. Then the pinchcocks controlling the several tubes are opened, and each tube, beginning with the one from the lowest plate and progressing upward, is raised to a point slightly higher than that at which bubbles first appear. Following this adjustment, release of the proper amount of compressed air into all plates simultaneously from the inlet manifold is accompanied by a steady flow of outgoing air from under each plate without a change in the level of the medium and without undue agitation of the surface of the liquid. As long as the apparatus is in operation a stream of air continuously passes over the mold under each plate. During the first three days of operation or until penicillin can be detected in the liquor, the outgoing air is characterized by a foul odor.

---

[1] Currently on leave from the University of California, College of Pharmacy, San Francisco.

The fermenter, air filter with inlet manifold, siphon tubes for introducing media and withdrawing samples, and the outlet tubes are sterilized as one unit. Since the outlet tubes are under continuous positive pressure during a run, it is unnecessary to provide filters for them, but of course they must be connected sterilely to the respective leveling tubes.

In frequently repeated trials with a working model of this apparatus, 40–45 per cent of the penicillin synthesized by *Penicillium notatum* 1249.B4[2] on a medium recommended for surface production of penicillin (*5*) was insoluble in $CHCl_3$ (two extractions in the cold at pH 2.2) but was soluble in amyl acetate. Differential assays were not performed on these samples, but their solubility characteristics were indicative of penicillin X. Yields of 60–70 Oxford units/ml. may be obtained readily in six or seven days on the above medium, and moderate-sized portions of approximately equal potency may be withdrawn at frequent intervals over a period of at least three weeks provided the initial volume of liquor is restored each time by addition of sterile medium. The same strain of mold on the same medium in the conventional bottle method of surface production run simultaneously consistently produced about 85–90 Oxford units/ml., 15–20 per cent of which was insoluble in $CHCl_3$.

The mean ratio of $CHCl_3$ insoluble/$CHCl_3$ soluble penicillins obtained in the apparatus for "submerged" surface cultures (about 10 runs) was 0.44. The lowest ratio obtained was 0.40, and the highest, 0.47. The range in conventional bottle production was 0.14–0.25 with a mean of 0.18.

Results of a typical run with a 10-liter laboratory model of the "submerged" surface fermenter are shown in Fig. 2. For this run the apparatus was set up with four plates and was charged with six liters of medium. At intervals samples were withdrawn from a level between the second and third plates. The points on the curve represent the total number of units of penicillin in the fermenter at the time indicated plus the total number withdrawn previously for assays, extractions, or other purposes; thus, a drop in the curve indicates that destruction of penicillin exceeded production during the period involved.

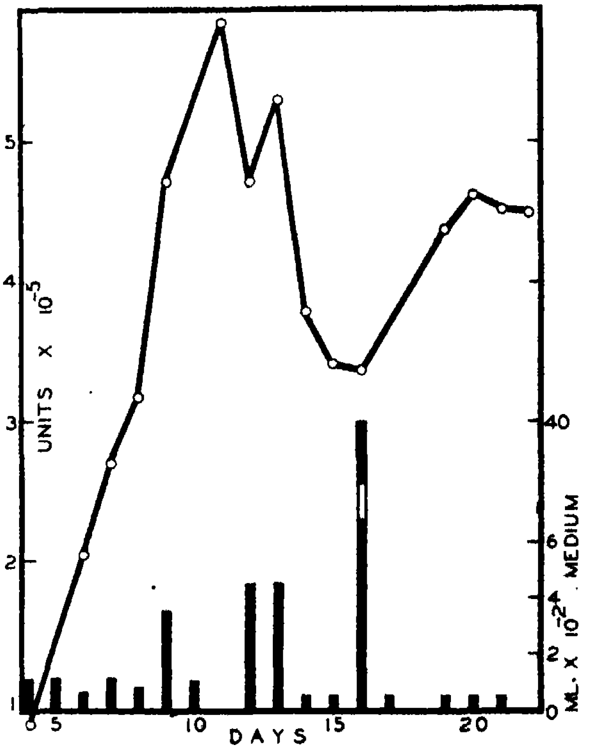


FIG. 2. *Curve*. Summary of penicillin production in run No. 7 with "submerged" surface fermenter. Ordinates show hundreds of thousands of units. *Bars*. Volume liquor removed and fresh medium added during run.

The vertical bars show the volume of liquor removed and replaced with fresh medium each day. The effect of addition of fresh medium is reflected for the first time in the assay for the following day. To facilitate visualization of this effect the bars have been displaced one day to the right on the abscissa. Thus, the volumes recorded for any given day were actually added to the culture on the preceding day.

It is interesting to note that the rapid destruction of penicillin evidenced after Day 11 was on two occasions counteracted and exceeded by increased production brought about by removal of considerable volumes of liquor and introduction of fresh medium. This experiment was discontinued at the end of the twenty-second day.

The optimum rate for removal and renewal of the culture liquor for maximum production of penicillin and of penicillin X has not yet been determined. Variables to be considered include geometry of the fermenter, particularly with respect to surface/volume ratios, rate of aeration, temperature, strain of mold, composition of the medium, and pressure to which the mold mat is subjected.

---

[2] This strain is a variant of *P. notatum* NRRL 1249.B21.

References

1. Flippin, H. F., Mayock, R. L., Murphy, F. D., and Wolferth, C. C. *J. Amer. med. Ass.*, 1945, **129**, 841.
2. Libby, R. L., and Holmberg, N. L. *Science*, 1945, **102**, 303.
3. Ory, E. M., Meads, M., and Finland, M. *J. Amer. med. Ass.*, 1945, **129**, 257.
4. Pratt, R. *Amer. J. Bot.*, 1945, **32**, 528.
5. Raper, K. B., Alexander, D. F., and Coghill, R. D. *J. Bact.*, 1944, **48**, 646.
6. Welch, H., Putnam, L. E., Randall, W. H., and Herwick, R. P. *J. Amer. med. Ass.*, 1944, **126**, 1024.

A Low-resistance Valve and Indicating Flowmeter for Respiratory Measurements[1]

Leslie Silverman and Robert C. Lee

Department of Industrial Hygiene, Harvard School of Public Health

Nutrition Laboratory, Carnegie Institution of Washington

In performing respiratory exchange experiments and measurements of respiratory air flow it is important that the valves for separating inspiration and expiration operate with low air-flow resistance and negligible back leakage. Dautrebande and Davies (*2*) have shown that the presence of appreciable breathing resistance in mask valves may alter the alveolar carbon dioxide concentration. Several low-resistance valves have already been described in the physiological literature, the principal ones being those of Pearce (*5*), Henderson and Haggard (*3*), and Bailey (*1*). Most of these valves may be suitable for measurements under resting or sedentary conditions but are not wholly satisfactory for working conditions when maximum air flows exceed 75 liters per minute. It is important to note that the maximum rate of air flow is specified here rather than the minute volume. The average inspiratory or expiratory air flow is approximately twice the minute volume during work, and the maximum air flows may be as high as three times the minute volume because of the shape of the respiratory air-flow curve *vs.* the time (pneumotachogram). The valve described in this article was designed primarily for experiments requiring heavy work rates and maximum effort either on a treadmill, bicycle ergometer, or hand ergometer.

In a recent article (*4*) we described a low-resistance valve (designated as a tubular valve) for use in a recording inspiratory air-flow instrument. While this valve was very satisfactory for experiments requiring low air-flow resistance and has a resistance of 0.1, 0.6, and 2.2 mm. of water at air flows of 25, 100, and 200 liters per minute, respectively, it is not entirely satisfactory when inspiratory and expiratory measurements are made together because of back leakage and air-volume changes on closure. This tubular valve was designed primarily to prevent passage of expired air into the inspiratory line. The valve described below is very low in resistance and also does not have significant back leakage.

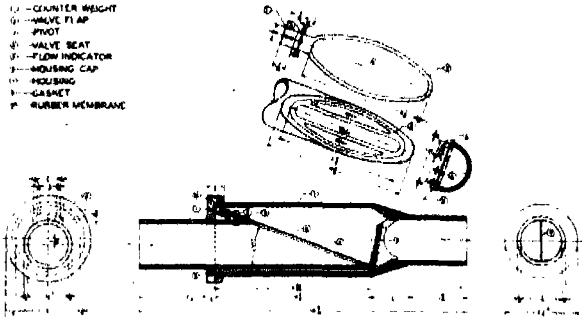


Fig. 1. Detail drawing of low-resistance valve construction.

The principles involved in the operating of this valve are fundamental in the design of respiratory valves. Such valves, in order to be low in resistance, should have negligible opening pressure and should offer little change in direction so that air-turbulence losses are not induced. The valve seating surfaces should have a small contact area so that they do not adhere to each other when wet. Wet conditions in expiratory valves result from condensation of exhaled moisture upon the expiratory valve surfaces. Treatment of the seating surfaces to prevent moisture absorption and wetting aids materially, but not completely, in reducing the moisture effect; hence it is desirable to provide that such surfaces have a minimum contact area.

Construction. The details of the valve construction are shown in Fig. 1. The original models of the valve were made of brass with aluminum frames covered with rubber membranes for valve flaps and glass cylinders for valve housings. The present models are now made of methyl methacrylate resin (Lucite) plastic. The only parts not made of this plastic are the rubber membrane, the rubber housing gasket, the metal counterweight, the metal flow indicator, and the metal flap pivot. The complete valve, when made of plastic, weighs 7.4 oz. (210 grams). The chief advantages of the plastic material are its light weight and transparency. The transparent plastic allows close inspection of the valve while it is in operation and counting of respiration rates.

---

[1] This work was done in part under Contract No. OEMsr-308 between the President and Fellows of Harvard College and the Office of Scientific Research and Development, which assumes no responsibility for the accuracy of the statements contained herein.

From Fig. 1 it is apparent that there are several mechanical features which incorporate the principles discussed above. It can be noted that the valve flap angle is very low (20°), and thus very little change in direction is necessary in permitting air to pass, once the valve begins to open. The area of the valve flap surface is large, and hence a low pressure will exert enough force to open it. The weight of the valve flap is offset by the counterweight. This counterweight (4 grams) was proportioned to give a low opening pressure and yet allow an adequate amount of positional movement of the complete valve. The seating surface of the valve is limited to the small longitudinal braces and edges of the seat periphery. In order to reduce the adhesive effect of the rubber membrane when wet, the seating surfaces are dusted with talcum powder. This powder prevents the rubber membrane and Lucite seating surface from wetting and also helps to preserve the membrane. The Tissot valve (*6*) also employs a hinged flap over an angular seat, but the angle with the vertical plane is very slight and the seating surfaces are metal.

The rubber membrane is very light-weight, thin, rubber sheeting having a thickness of 70 μ. This sheeting is cemented to the valve flap by rubber cement. We have found that the membranes will, in daily use, last from two to three months for inspiratory valves and one month to six weeks for expiratory valves. Severe pressure changes, such as occur at heavy work rates when resistance is introduced into the breathing line before the valve on inspiration or after the valve on expiration, do not affect the valve's efficiency. In time these pressure changes tend to stretch the membrane until it exceeds its elastic limit and does not remain plane. These changes are obviously apparent upon inspection, whereupon a new membrane can be cemented in place. The valve flap pivot consists of a small length of brass drill rod. The bearing surface is a hole drilled directly through the plastic flap slightly larger than the drill rod. No lubricant is necessary for this bearing.

The air-flow indicator feature of the valve is readily apparent from the operation of the valve. The deflection of the vane is measured by means of a small scale graduated in millimeters and made from thin sheet brass (0.25 mm.). The metal indicator scale is so thin that it does not offer appreciable resistance to air flow. This scale is primarily for the inspiratory valve, since fogging of the valve housing walls makes reading of the expiratory scale through the transparent wall rather difficult.

Valve operating characteristics. The resistance- and flow-indicating performance curves for the valve are shown in Fig. 2. As would be expected, the flow-indicator curve is the same on inspiration and on expiration (aspirating and blowing air through the valve), since both measurements were made under steady flows and inertial effects are eliminated. A comparison of the two conditions under pulsating flow will be given below. It can be seen from the flow-indicator curve (Fig. 2) that the counterweight is optimum for performance over the whole range of flows from 0 to 250 liters per minute. The curve is linear from 0 to 50 liters per minute and also linear from 50 to 160 liters per minute. The break in the curve at 50 liters per minute appears to be the point at which the effect of the counterweight is overcome by the pressure of the air stream. The sensitivity of the flow indicator can be increased by increasing the amount of the counterweight, but this increase will lower the air-flow range of the valve.

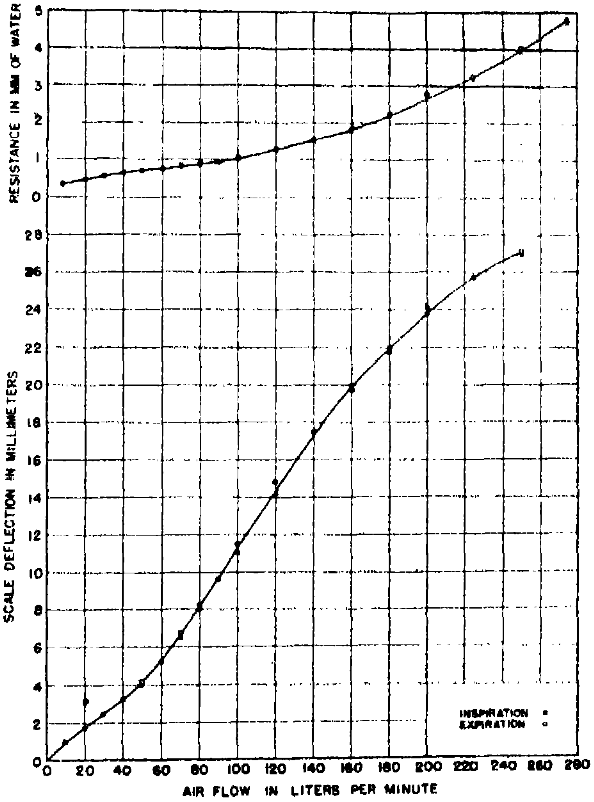


FIG. 2. Resistance and indicator characteristics of complete valve.
Lower scale—valve indicator response with increasing air flow.
Upper scale—valve resistance with increasing air flow.

The resistance curve in the upper portion of Fig. 2 was obtained by aspirating and blowing air through the valve. The resistance of the valve was measured by a tap connected to an 18.9-liter plenum chamber. It was found that the resistance so measured by this chamber test gave values comparable to actual conditions or conditions simulating actual breathing, such as a mannequin head provided with a mask and arranged so that air could be drawn into or blown into the mask cavity. In order to eliminate the entrance loss to the valve and to obtain resistance values comparable to actual use, a bellmouth or Borda mouthpiece was placed at the inlet. The valve is usually placed in a breathing line and preceded and followed by tubing. The bellmouth eliminates the necessity of a tap at the inlet of the valve when running chamber tests. When the inspiratory valve is not preceded by a recording instrument, gasometer, or other apparatus, a bellmouthed inlet should be used to reduce resistance to air flow especially at high air-flow rates. This information is not common knowledge among respiratory physiologists. When the bellmouth inlet is used, both inspiratory and expiratory resistance values agree as shown in Fig. 2. The opening pressure of the valve is less than 0.4 mm. of water, and the resistance is approximately 1 mm. of water at 100 liters per minute. Above 100 liters per minute the resistance increases exponentially, since the counterweight is overbalanced by the air flow and the orifice type of loss or exponential air-flow loss predominates. If the amount of the counterweight is increased (this can be done if increased indicator sensitivity and less stability to positional changes is desired), then the opening pressure and the resistance to air flow beyond 250 liters per minute will vary as an orifice loss, since the valve is fully opened at that rate of flow.

A comparison of the resistance of this valve with other physiological valves now in common use indicates that it is 10 to 20 per cent of their resistance above 75 liters per minute and approximately 30 per cent at lower flows. In all experiments with human subjects, when sedentary or working, no resistance to respiration could be detected when these valves were inserted into the breathing system.

The effect of the housing and the indicator scale upon valve resistance is not very significant. This is of interest because the valve can be used without the housing for expiration if it is not necessary to collect the expired air. For inspiration, however, the housing is always necessary, because it provides a means of connecting the valve to the system or mask. Above 100 liters per minute the housing adds 10 to 20 per cent increase in resistance from 150 to 250 liters per minute. The indicating scale offers no significant obstruction to air flow.

Leakage determinations on this valve were made by measuring the amount of air passing through the valve under conditions of increasing negative pressure. The range of pressures used corresponds to those which may be encountered in physiological experiments with respiratory apparatus. The valve leakage increases with increasing negative pressure, but the leakage is not appreciable (less than 25 ml. per minute) even at 40 mm. of water negative pressure. Dynamic leakage was obtained by a new method to be described later. This method measures the leakage throughout the breathing cycle by means of a new apparatus in conjunction with a respiration pump simulating actual respiration. The value obtained for dynamic leakage under conditions which correspond to sedentary and working subjects is of no significance in respiratory measurements since it is less than 0.2 per cent of the tidal volume.

The accuracy of the indicating scale as a means of estimating maximum air flow was checked under dynamic flow conditions by means of the dynamic air-flow instrument described by Lee and Silverman (*4*). The valve with indicating scale was placed in series with the air-flow instrument and several valve air-flow scale readings were noted for various volume and rate settings of a respiratory pump. The tidal volume and respiratory rate of the pump were adjusted within the range of human respiration. The indicating scale was calibrated at steady air flows, as shown in Fig. 2. A simultaneous scale reading and air-flow photographic record were taken for four or more respirations for each inspiratory and expiratory air-flow condition.

From these measurements it was observed that the indicator scale will give maximum flow readings to within 10 per cent, based on the mean of five or more observations. At high respiration rates the error of the valve indicator increases because of the greater inertia effect. The fact that almost all valve readings are greater indicates that inertia is present. At very low respiration rates this inertia may reduce the readings below the true air flow. There does not appear to be any significant difference between inspiratory or expiratory measurements although, as mentioned above, expiratory measurements on human subjects are difficult because of fogging of the valve housing by condensation of expired moisture. Simultaneous measurements were also made on a sedentary human subject who voluntarily controlled his breathing. These measurements gave comparable results to the pump measurements.

References

1. Bailey, C. V. *Proc. Soc. exp. Biol. Med.*, 1926, **24**, 184–185.
2. Dautrebande, L., and Davies, H. W. *Edinburgh med. J.*, September 1922.
3. Henderson, Y., and Haggard, H. W. *Amer. J. Physiol.*, 1925, **73**, 193–253.
4. Lee, R. C., and Silverman, L. *Rev. sci. Instr.*, 1944, **14**, 174–181.
5. Pearce, R. G. MacLeod's *Physiology and biochemistry in modern medicine.* (2nd ed.) St. Louis: C. V. Mosby, 1919. Chap. LXII.
6. Tissot, J. Respiratory apparatus, 1909. (U. S. Pat. 932,516.)

Letters to the Editor

Degradation of Streptomycin and the Structure of Streptidine and Streptamine

Recently the degradation of streptomycin to a diguanido base (streptidine) and the corresponding diamino compound (streptamine) was described, and evidence was presented that streptamine is either a 1,3- or 1,4-diaminotetrahydroxycyclohexane (*Science*, 1946, 103, 53–54). Convincing data have now been obtained supporting the former structure. Oxidation of N,N-dibenzoylstreptamine with periodate yields a substituted five-carbon dialdehyde (I) (m.p. 130–131° C.) which appears to exist in a hydrated cyclic form (1,3,5-trihydroxy-2,4-dibenzoylaminotetrahydropyran). The triacetyl derivative of I is a beautifully crystalline substance (m.p. 217° C.). Oxidation of I with bromine water yields a dibenzoylaminohydroxyblutaric acid (m.p. 197–198° C.). These products are to be expected from 1,3-diaminotetrahydroxycyclohexane but not from the 1,4-diamino isomer. Hence, these data, in conjunction with the previously presented evidence, establish the structure of streptamine as 1,3-diamino-2,4,5,6-tetrahydroxycyclohexane. Streptidine is the corresponding 1,3-diguanido compound.

Streptamine is optically inactive and probably represents one of the eight possible *meso* forms. Correlation of the configuration of streptamine with that of *meso* inositol is an interesting problem with which we are now engaged.

H. E. Carter, R. K. Clark, Jr., S. R. Dickman,
Y. H. Loo, P. S. Skell, and W. A. Strong
Noyes Laboratory of Chemistry, Urbana, Illinois

Scientific Research and National Welfare

H. S. Reed (*Science*, 1945, 102, 524) apparently writes in behalf of the Executive Committee of the Pacific Division of the AAAS and makes certain statements to which one might take serious objection. The conclusion of his letter reads as follows: "For the first five years the Board of Research and Development could utilize existing laboratories. No greater mistake could be made than to spend large sums at present in the construction of Federal laboratories. It would be much better to make grants of funds to private industrial laboratories or educational institutions under the supervision of the Board of Directors. It will take nearly five years for the board to prepare an adequate program for research. In its essence, men and their intellects are the important things in research rather than lofty buildings. I am not in favor of having the research funds spent in the existing laboratories of the Federal Government because I do not believe that there are now men in those laboratories who are capable of directing basic scientific researches, except in a few cases."

The undersigned, in the belief that the somewhat unfortunate wording of the above statement was not intended to be taken literally, is writing this letter for the purpose of clarification of the terminology used, in the hope that this clarification will have sufficient circulation through the medium of *Science* to rectify the unfortunate impression which a misunderstanding of terminology implies.

As a pure academic scientist, the undersigned (in his capacity as reserve officer in the U. S. Navy) has been closely associated with aspects of the problem of national scientific welfare in connection with national defense. In an attempt to clarify this problem the undersigned published an article entitled "Naval research in peace and war" (*Proc. nav. Inst.*, 1945, 71, 1169). In this article some clarification of the terminology and the necessity for adequate support of Federal research laboratories for national defense were set forth in detail. In what follows the essence of this analysis, pertinent to Prof. Reed's letter, is presented with the hope that it will serve to clarify the situation:

What Dr. Reed and many others do not appreciate is that there is much more to the question of industrial and national defense research than is implied in the pure scientists' view of research. The undersigned has chosen to classify three aspects of the scientific research as it affects national welfare. These are: (1) the pure or *fundamental research* which leads to an understanding of the laws of nature, the discovery of new facts and laws, and the theoretical development of that knowledge; (2) the *basic research* as it applies to industrial or military development involving basic studies of the fruits of fundamental work to determine their potentialities antecedent to application; (3) the *applied research* and development.

Each of these phases is essential to national welfare, and each has its own specific requirements and qualifications. Thus, *fundamental research* must be unrestricted as to problems, mode of attack, scope, freedom of publication, etc. It is vital to the country's welfare, for whatever nation is paramount in *fundamental research* will also excel in the other phases. The logical place for this work is primarily in the academic environment and perhaps in a few specially equipped industrial and government laboratories. Primarily, government laboratories are intended to furnish research of types *more immediately* profitable to the Nation's needs and welfare, which must in some degree limit the amount of the often wasteful effort which goes into pure or *fundamental research.*

Basic research is usually somewhat more expensive. It requires larger fields for application and test and is definitely the concern of academic engineering schools, industrial laboratories, and the Federal Government laboratories. It perhaps should not have too many restrictions on freedom of effort, method of attack, and freedom of publication. However, in many questions vital to the Nation's welfare there may be urgent need for secrecy or classification. This point is often overlooked. Such classified research is inimical to the spirit of academic institutions. Because of this influence as well as the difficulty in maintenance of security, except in the academic engineering field where free publication should be required, this work should not be done in such institutions.

The *applied research* and development of devices is obviously the sole concern of industry and the Federal Government. It is far too costly to be carried out in academic centers and is definitely of utilitarian import. Some of this material can and must be published, at propitious stages of development. Other aspects of this work, both in industry and the Government, must be kept restricted for security purposes. The writer, being familiar with the defense aspects of the problem as it affects the Navy, is convinced that while part of the *basic research* on such measures can be farmed out to industry, it is essential for security reasons as well as for the proper development of the devices that such work be carried out in laboratories directly under the agencies involved.

This statement follows, since the industries are not operated directly for the public and have their own interests and problems, and is based on experience. The need of Federally controlled laboratories applies equally to *basic studies* such as those carried out by the National Bureau of Standards and the U. S. Department of Agriculture, irrespective of whether the material is classified or not. Experience has shown that under these conditions the only solution is to endow the national defense agencies and other Federal agencies charged with specific problems sufficiently to insure the national welfare. Such endowment and support is vital to the national welfare and must receive its share of support with other research activities.

The undersigned cannot agree with the statement of Dr. Reed in saying: "I do not believe that there are now men in those laboratories who are capable of directing basic scientific researches, except in a few cases." This is quite contrary to the experience of the writer, which has been far from limited, even if the writer's term "fundamental" replace the word "basic." There are many highly able and brilliant research men capable of fundamental research work in these laboratories. That they have not done much work of this character results from the fact that they are employed for other purposes and do these well.

It is admittedly true that Federal scientific agencies have suffered under severe handicaps in the past, such as low salaries for the more highly placed technical personnel, difficulties in employment conditions by Civil Service restrictions, and budgetary restrictions. These are conditions that should, and will, be improved. However, it does not assist in improving the situation or in encouraging good men to assist in the necessary Federal Government conduct of research to have such statements as those of the Executive Committee of the AAAS broadcast.

LEONARD B. LOEB, Capt., USNR
Professor of Physics

Temperatures in Deep Wells and the Ice Age

In *Science* (1945, 102, 334–335), the writer published an article entitled "Temperatures in some deep wells in Pennsylvania and West Virginia." A study of the data indicates that, in general, the rate of increase in degrees Fahrenheit, per unit increase in depth, becomes greater.

It has been suggested that the lower temperatures of the recent ice age might be responsible for this phenomenon. The tundra regions of the high latitudes in Asia and North America are frozen, at present, to depths of hundreds of feet and in northern Siberia to a thousand feet or more. The wave of low temperatures of the ice age may be working its way to still lower levels. It is reasonable to suppose that a large area in the United States, during the ice age, was frozen to considerable depth. This might explain the lower rate of increase in temperature per unit of depth nearer the surface than at greater depths.

KARL VER STEEG

College of Wooster, Wooster, Ohio

Consultant Articles

The purpose of this letter is to suggest a method by which scientific evidence may be tested to determine its validity. It is a common observation that some long-established misconceptions may prevent the acceptance of new observations and thus impede the progress of science. Granting this to be true, science needs fact-finding boards to determine whether or not the evidence presented is sufficient to support a new hypothesis.

The discussion of scientific reports at meetings may air a subject to a certain extent, but generally this is inadequate to test the correctness of new evidence. Those workers who might be able to judge the results rarely express a definite opinion because they wish to have more time for thought and possibly for experimentation. After leaving the meeting, their own problems again occupy all their attention, and so acceptance of a new concept may be delayed year after year.

The "consultant article" appears to offer a solution. By this means an investigator who decides to submit his observations to a searching analysis can determine whether or not evidence supporting his hypothesis meets the approval of authorities in his particular field.

The method of setting up consultant articles has been used in various forms in the *Journal of Dental Education*, in which more than 30 such articles have appeared since 1939. Even textbooks lend themselves to this method of authoritative presentation. B. Orban, together with 18 other authors, prepared a work (*Oral histology and embryology*. St. Louis: C. V. Mosby, 1944) in which each chapter was written by an authority, the entire text then being submitted to all authors a number of times for revisions, additions, and deletions.

Experience has shown that the author of a consultant article must present his evidence clearly and briefly. The principal issue must be focused definitely to limit discussion to major data. This can be done by referring a number of questions to the consultants which are pertinent to the controversial material. These questions should be so phrased that they require definite answers, such as ''yes,'' ''no,'' or ''possibly true.'' When a consultant answers in the negative, he is asked to present evidence to support his contrary opinion. The discussion of consultants may be rounded out further by including their opinions of the paper as a whole and stating their approval or disapproval.

The number of consultants necessary to present a good discussion varies. Usually 5 or 6 are sufficient, although the discussion concerning a generally held misconception may require as many as 15 or 20 consultants. After conference with the author, consultants are selected by the editor of the periodical in which the article is to be published. If the author selected as consultants only those whose views agreed with his, he would defeat his purpose. He must consider authorities of contrary opinion a well as those in agreement with him. It is clear that the opinion of the readers will depend greatly on the previously published views of the consultants. The principal purpose of consultant articles is to ascertain whether or not the available evidence is sufficient to convince those men who, in the past, have held contrary views.

When all consultants have submitted their discussions, the author has the privilege of answering their criticisms. He often finds this opportunity highly instructive. The author may note that (1) a certain phase of his evidence is not quite as conclusive as he believed; (2) the evidence was unknown to some consultants; (3) some of his statements have been misinterpreted by consultants due to lack of clarity; (4) photomicrographs, charts, graphs, or other material used as evidence supporting his findings were insufficient in number or not sufficiently clear to gain conviction. All of these data may be discussed by the author in order to interpret and correlate all opinions. The closing discussion should be brief, yet sufficiently comprehensive to allow the busy reader to glean from this concluding statement an idea of the status of this controversial subject.

Past experience has shown that consultant articles can be made highly authoritative and instructive. By means of cooperation between the leaders in specialized fields, obsolete material may be eliminated more rapidly and the value of new hypotheses tested, resulting in the more rapid progress of science.

CHARLES F. BODECKER
School of Dental and Oral Surgery
Columbia University Medical Center, New York City

Research Service Laboratories

As research grows more specialized the methods used become more complex, and progress in one field is increasingly dependent on advances in knowledge and techniques in other fields. Scientists find it increasingly difficult, however, to keep informed concerning current developments in their own fields, and practically impossible to keep up with advances in other fields. Thus, it seems that just at the time when our dependence on other fields is increasing, our ignorance of them is heightening. This situation emphasizes the importance of cooperation and consultation between departments. The advantages of being able to consult with competent advisers concerning the planning of efficient experiments and the construction of reliable apparatus are obvious to all who have ever developed research programs. Much time and money are wasted trying to improvise apparatus because no expert is available to give advice or to build reliable apparatus. Probably even more time and money are wasted on poorly designed projects which yield inadequate and inconclusive results, but which, if properly planned, would have yielded satisfactory results with the expenditure of less time and money.

While we usually find our colleagues in other departments willing to advise us, we generally consult them with some reluctance because we know that they could spend their time more profitably on their own problems. This situation might be remedied by the establishment of what Klopsteg calls ''laboratories of instrumentology'' to assist investigators in developing better methods and apparatus for research (*Science*, 1945, 101, 569). The program proposed by Klopsteg is too elaborate and too expensive for any but the largest universities, but much can be done to increase the efficiency of research in institutions of moderate size by supplying a few of the more essential services.

Perhaps the most useful service is an adequately equipped instrument shop, supervised by an ingenious and cooperative instrument maker. In view of the increasing use of electronics and electrical instruments of all sorts, a consulting physicist with special training in electricity and electronics is highly desirable. The services of a glass blower are often needed, but individual conditions would determine whether or not an institution of moderate size can afford a full-time man. One solution is for two adjacent institutions to cooperate by sending all their work to a shop maintained by one of them. Another essential service is a statistical laboratory in charge of an expert in the design of experiments and the analysis and interpretation of data. Such a consultant can add greatly to the efficiency of research by eliminating the waste of time and money resulting from poorly planned experiments. While most investigators have a fair knowledge of experimental techniques, few have had adequate training in planning experiments and evaluating the reliability of data. Various other forms of service can be developed to fit the needs of research in particular institutions.

Probably most institutions have some of the services mentioned, but in only a few instances are they specifically organized to serve investigators in all departments. Service laboratories should ordinarily be administered by the departments to which they are naturally related. Investigators using them should be charged for the time and materials used on their projects. Free services are never as much appreciated as those which must be paid for, and a charge prevents a few self-centered individuals from completely monopolizing the services of a laboratory.

It should be emphasized that the success of such laboratories depends largely on the training and personality of the men in charge. Not only must they be well informed in their own fields, but they must have broad interests, ingenuity, curiosity, and a real desire to cooperate with their colleagues in other fields in solving a wide variety of problems.

PAUL J. KRAMER
Department of Botany, Duke University

On Introductory Biology Courses

In the recent discussion of the nature of the elementary course in biology reported by Dr. Hamburger (*Science*, 1945, 102, 511–513), consideration was given to the problem of whether a single course in general biology should be given for all students, general and professional, or whether a special course should be set up for the latter. At Stanford University both methods have been tried, and the author has taught under both plans. The staff has been sufficiently large to allow two introductory courses, so the choice has depended upon the performance of the students. Our plan and experience might therefore be of interest to others.

Stanford was one of the pioneers in giving a general biology course designed primarily for the liberal arts student and organized along lines quite different from the classical courses in botany and zoology (L. L. Burlingame and E. G. Martin, *Science*, 1920, 51, 452–455). This course and its successors have used the principles of biology and their corollaries as the basis of organization. Thus, the broader concepts of biology are emphasized as the basis of an understanding of the functioning of the human body and the place of man in nature as one of the animals in a community of organisms.

On the other hand, such a course, while excellent for the liberal arts student, may not necessarily be the best beginning for the person who, by virtue of high school training or a strong interest in organisms awakened in some other way, already has a fair understanding of the general concepts and is anxious to begin directly on his professional training. In two attempts to put all students together—majors in biology, premedical and liberal arts students—we have had this brought to our attention strikingly. The pace necessary for the newcomer is too slow for the student already introduced to biology. The repetition of the same material as he had in high school is not most stimulating to him. On the other hand, accelerating the course or making it more intensive soon carries it beyond the ability of the newcomer. Segregation of the majors and premedical students into a special advanced laboratory section helps but does not solve the problem, for the lectures are still aimed mainly at one group. As a result of these experiences the professional and premedical students were allowed to elect plant and animal biology instead of general biology. This most of them did, although some, feeling the need of orientation, took general biology. Both routes are allowed to serve as an introduction to the advanced professional courses.

In the introductory plant and animal biology courses the plan has been to introduce the student to the major plant and animal groups, their behavior, nutrition, structure (gross and histological), life cycles, and evolution. In so far as is feasible, principles of adaptation, distribution, homology, recapitulation, evolution, and heredity are considered when the material favors their discussion, and the cell theory serves as a unifying principle throughout.

The professional and premedical student does not receive adequate training in all the principles of biology in his introductory plant and animal biology courses, since time is inadequate for this purpose. On the other hand, by the time he finishes a good advanced sequence in his professional field he will have been introduced to all the principles of biology, each strongly reinforced by a body of data far in excess of that possible in the general biology course. If he still needs a general treatment of the principles of biology and their application to man, a course on the senior level, encouraging him to focus his attention on the principles and to weld these into a philosophy of biology, might serve his needs far better than time taken out at the elementary level.

Such a double entry into biology may require more staff, and it taxes the type of adviser who wishes to rubber-stamp all college entrants. Inasmuch as the entrants are diverse in ability, background, and training, why not recognize and take advantage of this diversity as well as of the differences in objectives and subsequent training an individual is to receive? While all members of our own staff are not in complete agreement on this arrangement, practice has borne it out as preferable under local conditions. It would be interesting to know the experience of others in this regard.

ARTHUR C. GIESE
School of Biological Sciences, Stanford University

Support of Scientific Research

In reading the various interesting and stimulating discussions of different aspects of the proposed national legislation for the support of scientific research, there is one phase of the problem that seems to me to have been largely, if not entirely, overlooked. This is the educational value to a democracy derived from the individual support of such work. There has been a well-organized effort in this country to emasculate the emotional and participative factors in individual charity and philanthropy.

Community chests with pooled and budgeted objectives are undoubtedly, on paper, an efficient method of giving. By the conduct of a single campaign covering many needs it effectively obviates the necessity of the donor investigating and considering the individual needs. It is a soporific to individual responsibility and tries to make giving an easy and comfortable process devoid of any unpleasant realities that make the donor even temporarily uncomfortable. It kills thought and, with thought, imagination. It attempts to do for charity toward one's neighbor what many of the organized religions have done to man's thoughts about a deity, namely, make them less a personal and more an organisational responsibility.

Support of education and of research by taxation is much the same sort of process. One's taxes are rarely itemized in proposed expenditure although analyzed *ad nauseam* in origin of income. When one's Federal taxes are paid, personal interest in their expenditure promptly and unfortunately ceases for the average man unless some flagrant abuse or scandal is later unearthed or unless they are abruptly or extensively increased.

This country sorely needs more, rather than less, individual appreciation of its educational and research problems. It can gain this end best by forcing greater rather than less, individual participation in raising funds for these purposes.

The experience of the American Cancer Society is a large enough example of this principle to be significant and impressive. This Society has long recognized that cancer obviously and insistently requires individual responsibility, knowledge, and action for its ultimate conquest. The Society has gone far along the road toward arousing the American public to its essential part in the fight against this disease. The effort has required time, hard work, and faith in the average American citizen. It has, however, begun to prove its soundness by the results already obtained, and its permanency by the increased evidence of autocatalytic increase in interest by the public.

A democracy which could and did obtain its support of scientific research in the same way would send the roots of intelligent, personal giving deep into the soil of its citizenry. These roots in turn would make that soil more porous to education and more fertile in contributing succeeding generations of better-equipped and more cooperative men and women who would understand more completely and naturally their duties as citizens of a free state.

Government support of research involves no new principle. It has a long and distinguished record of achievement to its credit. It can well be greatly extended and broadened. It is only when it becomes too regimented, circumscribed, or handicapped by administrative methodology that it becomes dangerous in just the same way that these same impersonal and overorganizational factors can endanger individually supported research.

There is a very real place for government support of research but it might well be in cooperation with increased private and individual effort. Neither system alone is as strong as a combination of the two, for when both exist together there is a chance to compare the results and to supplement one another where mutual interests are involved. Each can learn by the mistakes of the other. Each can use the experience as a valuable "laboratory course" in the relationship between individual and Federal responsibility.

The main point is that both governmental and private support of research need and must have a continuing individual educational emphasis so that both may constantly be more intelligently and universally supported by citizens who know what they are supporting and why.

The time to establish this principle is now. If we delay we shall find it increasingly difficult to introduce it at a later date.

C. C. Little

Roscoe B. Jackson Memorial Laboratory
Bar Harbor, Maine

Book Reviews

Pulmonary edema and inflammation. Cecil K. Drinker. Cambridge, Mass.: Harvard Univ. Press, 1945. Pp. viii + 106. (Illustrated.) $2.50.

This book is of particular importance because it is the only publication at present available in which the factors involved in the excessive accumulation and distribution of fluid within the pulmonary system are presented. Observations based on experimental technics devised by Drinker, Warren, and their associates for determining quantitatively the pulmonary lymph flow in the dog form the groundwork for a discussion of the mechanisms of pulmonary edema and its treatment. Four of the five chapters are based on the Nathalie Gray Bernard Lectures given by Dr. Drinker at the Bowman Gray School of Medicine. A fifth chapter on artificial respiration completes the book.

The anatomy and physiology of the lung are discussed in relation to transudation. It is pointed out that the pulmonary capillaries, unlike all other capillaries, depend for their oxygen supply on air reaching the individual alveoli and not on arterial blood. The presence of fluid in the alveoli or bronchioles excludes air and thereby produces anoxia of the involved pulmonary capillaries. Experimental observations in the dog are presented in detail and interpreted to show that anoxia produces excessive leakage of fluid from the pulmonary capillaries, whereas increased capillary pressure does not readily cause recognizable pulmonary edema. The pulmonary lymphatic system in the dog is extensive and drains into the right subclavian vein by way of the right lymphatic duct. The right lymph duct is small and limits the rate of pulmonary lymph flow. A new drug, related to thiourea, which is capable of producing pulmonary edema was used to demonstrate the inadequacy of the lymphatic system in the dog as a means of removing excessive amounts of fluid from the lung. Variations in lung movement and expiratory and inspiratory resistances were found to affect the rate of pulmonary lymph flow. There is an excellent critique of various methods of artificial respiration in which a strong stand is taken against the use of mechanical resuscitators.

Dr. Drinker recommends the administration of oxygen under higher than atmospheric pressure for the treatment of pulmonary edema, on the ground that the added pressure will oppose filtration from the pulmonary capillaries. To this reviewer it does not appear that the application of the recommended 6 cm. of water pressure at the mouth of a patient will oppose capillary filtration to a significant degree. We have found that the pressure available for opposing capillary filtration cannot be assumed to be equal to that applied at the mouth, since roughly half of the applied pressure is transmitted to the intrapleural space, this transmitted portion increasing the pressure in the pulmonary artery and vein. It is improbable that the resulting pressure increase, which would amount to 2 to 3 cm. of water, would exert significant counterpressure to oppose capillary filtration.

A discussion of the pathogenesis of pulmonary edema in man is a difficult one to write at this time, because blood pressure in the pulmonary capillaries, oncotic pressure of the plasma proteins in the pulmonary circulation, and tissue tension have not been measured quantitatively in man, nor are the factors governing variations in the passage of fluid through the capillary wall understood. Perhaps the application of the right heart catheterization technic in man will be productive of significant quantitative data on pressure relationships in the lesser circulation in relation to the problem of pulmonary edema. Dr. Drinker has performed a difficult task well. *Pulmonary edema and inflammation* is stimulating and fills a gap in medical literature. The book is highly recommended.

HERBERT CHASIS

New York University College of Medicine

Insect dietary: an account of the food habits of insects. **Charles T. Brues. Cambridge, Mass.: Harvard Univ. Press, 1946. Pp. xxvi + 466. (Illustrated.) $5.00.**

In this book the author presents an account of the food habits of insects which is very comprehensive in coverage and quite readable. Each chapter is supplemented with an excellent bibliography of the special subject under discussion, thus bringing together a great many resources for the student of insects not hitherto of easy access.

The book does not, as might be expected from the title, go into the chemical phases of insect food or into insect metabolism, which might have interested some students more, but which would have made the book less interesting to the inquirer about insect food habits. The chapter on abundance and diversity of insects assembles many estimates of insect populations under diverse specific conditions. The stupendous numbers per acre in many of these estimates would be hard to believe if they were not the conscientious estimates of many observers. Dr. Brues then proceeds to analyze the food habits in relation to structure and environment, follows with separate chapters on the herbivorous insects, the gall makers, and the predators and parasites. An interesting chapter is that on the use of fungi and microbes as food of insects, and the insect symbiosis with such microorganisms. This is a subject seldom treated in textbooks, and consequently the long bibliography will be of great use. The parasitic insects are divided into the external parasites of vertebrates and the internal parasites of insects and vertebrates. The final chapter considers the insects as food of microorganisms, of insectivorous plants, and of lizards, amphibians, birds, mammals, and man.

On the whole, this is a very useful book, packed with information and references to stimulate further research. It will be invaluable to lecturers.

W. DWIGHT PIERCE

Los Angeles County Museum
Los Angeles, California

Dvorine color perception testing and training charts. **(Vol. I: Testing charts; Vol. II: Training charts.) Israel Dvorine. Baltimore: Israel Dvorine, 1944. $25.00.**

This work consists of two volumes of color plates and a brief pamphlet of instructions. Although the jacket states that these are "the first set of pseudo-isochromatic charts developed by an American," the construction of the plates follows that of the Ishihara, Rabkin, and Stilling plates, retaining most of their faults but lacking valuable diagnostic features of the older plates. It appears that the fundamental researches of the last half century, including those of Pitt, Wright, and Judd, have been ignored.

The Introduction states: "The colors of these charts are based on the subtractive color theory; that is, that the primary colors are red, yellow and blue. . . ." This is a useful working principle for mixing printing inks, but it bears no relation to the design of a color system which diagnoses color blindness.

The claim that the system "selects individuals who are not color blind but who merely become visually confused by certain color combinations" is a dangerous play on words. The Navy, for instance, cannot afford to use men who "visually confuse" red and green light signals.

It is claimed that the second volume is useful in the training of color vision. There is no doubt that men can be "trained" to improve their scores on pseudo-isochromatic tests, but there is no indication that men are less color blind as the result of such training. Rather, this proves that such tests are defective as measuring instruments. The net result of the present widespread teaching of "how to pass the plates" is merely that better and less learnable methods for testing color vision will be developed and substituted.

DEAN FARNSWORTH, LT. CDR., USNR

U. S. Submarine Base, New London, Connecticut

Scientific Book Register

Abt, Isaac A. *1945 year book of pediatrics.* Chicago: Year Book Publishers, 1946. Pp. 448. (Illustrated.) $3.00.

Alexander, Jerome. (Ed.) *Colloid chemistry: theoretical and applied.* Vol. VI: *General principles and specific industries; synthetic polymers and plastics.* New York: Reinhold, 1946. Pp. vii + 1215. (Illustrated.) $20.00.

Amsden, John Page. *Physical chemistry for premedical students.* (1st ed.) New York-London: McGraw-Hill, 1946. Pp. ix + 298. (Illustrated.) $3.50.

Barbour, Thomas. *A naturalist's scrapbook.* Cambridge, Mass.: Harvard Univ. Press, 1946. Pp. x + 218. (Illustrated.) $5.00.

Benson, Lyman D., *et al. Manual of trees and shrubs of the southwestern desert.* Tucson: Univ. Arizona, 1945. Pp. 411. (Illustrated.) $3.00.

Broster, L. R. *Endocrine man: a study in the surgery of sex.* New York: Grune and Stratton, 1945. Pp. xi + 144. $3.50.

Bunn, C. W. *Chemical crystallography: an introduction to optical and X-ray methods.* Oxford, Eng.: Clarendon Press, 1945. Pp. xii + 422. (Illustrated.) $7.50.

Cable, Emmett James; Getchell, Robert Ward, and Kadesch, William Henry. *Science in a changing world.* (Rev. ed.) New York: Prentice-Hall, 1946. Pp. xvii + 622. (Illustrated.) $5.00.

Cahn, Lester, *et al. The 1945 year book of dentistry.* Chicago: Year Book Publishers, 1945. Pp. 703. (Illustrated.) $3.00.

Cook, Robert, and Burks, Barbara S. *How heredity builds our lives: an introduction to human genetics and eugenics.* Washington, D. C.: American Genetic Association, 1946. Pp. 64. (Illustrated.) $.75.

Cornett, R. Orin. *Algebra: a second course.* New York: McGraw-Hill, 1945. Pp. 326. (Illustrated.) $2.00.

Darlington, C. D., and Ammal, E. K. Janaki. *Chromosome atlas of cultivated plants.* London: George Allen and Unwin, 1946. Pp. 397. $2.75.

Degener, Otto. *Plants of Hawaii National Park illustrative of plants and customs of the South Seas.* New York: New York Botanical Garden, Bronx Park, 1946. Pp. 329. (Illustrated.) $2.50.

De Ment, Jack. *Fluorochemistry: a comprehensive study embracing the theory and applications of luminescence and radiation in physicochemical science.* Brooklyn: Chemical Publishing Co., 1945. Pp. xvii + 796. (Illustrated.) $14.50.

Dougherty, Joseph M., and Lamberti, Anthony J. *A textbook of bacteriology and immunology.* St. Louis: C. V. Mosby, 1946. Pp. 360. (Illustrated.)

Dunbar, Helen Flanders. *Emotions and bodily changes: a survey of literature on psychosomatic interrelationships, 1910–1945.* (3rd ed.) New York: Columbia Univ. Press, 1946. Pp. 663. $7.50.

Farrell, John T., Jr. *Roentgen diagnosis of diseases of the gastrointestinal tract.* Springfield, Ill.: C. C. Thomas, 1946. Pp. 271. (Illustrated.) $5.50.

Fisher, Douglas A. (Compiler.) *Steel in the war.* New York: U. S. Steel Corp., 1946. Pp. 164. (Illustrated.)

Ford, Clellan Stearns. *A comparative study of human reproduction.* (Yale Univ. Publ. Anth., No. 32.) New Haven: Yale Univ. Press, 1945. Pp. 111. $1.50.

Grant, Julius. (Ed.) *Quantitative organic microanalysis: based on the methods of Fritz Pregl.* (4th English ed.) Philadelphia: Blakiston, 1946. Pp. vii + 238. (Illustrated.) $5.00.

Hardenbergh, William Andrew. *Water supply and purification.* (2nd ed.) (International texts in civil engineering.) Scranton, Pa.: International Textbook Co., 1945. Pp. 502. (Illustrated.) $4.00.

Headlee, Thomas J. *The mosquitoes of New Jersey and their control.* New Brunswick, N. J.: Rutgers Univ. Press, 1945. Pp. x + 326. (Illustrated.) $4.00.

Heitler, W. *Elementary wave mechanics.* Oxford, Eng.: Clarendon Press, 1945. Pp. viii + 136. (Illustrated.) $2.25.

Hoffman, Adolphe. *Faune de France 44: Coléoptères bruchides et anthribides.* Paris: Paul Lechevalier, 1945. Pp. 184. (Illustrated.) 250 fr.

Hopkins, B. Smith, and Bailar, John C., Jr. *Essentials of general chemistry.* Boston: D. C. Heath, 1946. Pp. v + 520. (Illustrated.) $3.50.

Keys, Thomas E. *The history of surgical anesthesia.* New York: Schuman's, 1945. Pp. xxx + 191. (Illustrated.) $6.00.

Leffingwell, Georgia, and Lesser, Milton. *Soap in industry.* Brooklyn: Chemical Publishing Co., 1946. Pp. viii + 204. $4.00.

Lewis, Nolan D. C., and Pacella, Bernard L. (Eds.) *Modern trends in child psychiatry.* New York: International Univ. Press, 1945. Pp. 341. (Illustrated.) $6.00.

Mumford, Lewis. *Values for survival: essays, addresses, and letters on politics and education.* New York: Harcourt, Brace, 1946. Pp. x + 314. $3.00.

Richter, Victor von. (Edited by Richard Anschütz.) *The chemistry of the carbon compounds*: Vol. III: *The aromatic compounds.* (3rd English ed.) New York: Elsevier Publishing Co., 1946. Pp. xviii + 794. $15.00.

Séguy, Eugène. *Faune de France 43: insectes ectoparasites (Mallophages, Anoploures, Sephonaptères).* Paris: Paul Lechevalier, 1944. Pp. 684. (Illustrated.) 800 fr.

Snyder, Laurence H. *The principles of heredity.* Boston: D. C. Heath, 1946. Pp. xvi + 450. (Illustrated.) $3.75.

Solomon, Arthur K. *Why smash atoms?* (Rev. ed.) Cambridge, Mass.: Harvard Univ. Press, 1946. Pp. xii + 204. (Illustrated.) $3.00.

SCIENCE

Vol. 103, No. 2679 Friday, May 3, 1946

Hybrid Seed Corn

George Harrison Shull

Professor Emeritus of Botany and Genetics, Princeton University

IT IS NOW 41 YEARS SINCE I BEGAN the studies of variation in maize as affected by inbreeding, which led me to propose the procedure in corn production that is now generally known as "hybrid corn." My own name for the method was "a pure-line method of corn breeding," and my paper published under this title was read before the American Breeders Association in Columbia, Missouri, slightly more than 37 years ago. I grew my last experimental crop of corn in 1916, 30 years ago.

These facts illustrate well a frequent historical phenomenon, namely, the long interval which may elapse between the making of a fundamental discovery and the general understanding of its importance and full realization of its benefits.

The most notable example of this phenomenon is seen in the discovery and rediscovery of the Mendelian principles of heredity. The chief difference between the history of Mendelism and that of hybrid corn is that within the interval of 35 years between discovery and rediscovery Gregor Mendel died, mindful of the importance of the discoveries he had made, but wholly unaware that 16 years after his death he would receive the recognition that was his due. I have the comfortable distinction of having outlived the interval between discovery and rediscovery, and I now have the satisfaction of knowing that the results of my work will continue to benefit mankind for all time.

In thus expressing my happiness in the thought that my work has been of permanent value, I want you to know that I am fully mindful of the fact that I am only one of many who have made crucial contributions to the benefits that hybrid corn is now giving and will give more and more abundantly with the passing of the years. This award belongs, in reality, to the whole field of workers who have, each in his own way, helped to bring the hybrid corn program with truly amazing speed so far on its way to full fruition.

In all humility I admit that, regardless of any merit my own work may have to my contemporaries, there would be no hybrid corn now had there been no one else with vision, courage, enterprise, and persistence to carry on from where I left off in 1916. I like especially to think of Edward Murray East, Henry A. Wallace, Donald F. Jones, F. D. Richey, Merle T. Jenkins, W. Ralph Singleton, and many other workers at the Agricultural Experiment Stations, as well as at least a dozen great commercial companies which are now producing the major part of the many millions of bushels of hybridized seed-corn required by American farmers each year.

Some seven years ago at the annual dinner of the American Society of Naturalists held in New York City, I sat between Dr. Ivey F. Lewis, of the University of Virginia, who was then president of the Society, and Dr. William J. Robbins, the newly-appointed director of the New York Botanical Garden.

The John Scott Medal Fund derives from a gift of John Scott, chemist, St. Patrick's Square, Edinburgh, Scotland, to the city of Philadelphia in 1816. The original amount of the bequest was $4,000, and by 1917 the principal sum had grown to $100,000, whereupon court action was taken to increase the amount of annual awards from the original stipulated value of $20. Almost 500 awards have been made in the 130 years that the fund has been in existence. Between 1920 and 1945 ninety-five awards have been made under the sponsorship of the advisory committee which is at present composed of: Arthur H. Compton, Edwin G. Conklin, Harry L. Frevert, J. F. Metten, Thomas A. Shallow, Harlow Shapley, J. E. Shrader, Philip C. Staples, Harold C. Urey, S. M. Swaab (secretary), and Ernest T. Trigg (chairman).

In 1945 there were several recipients, among whom Dr. George H. Shull, the originator of hybrid corn, was one.

Dr. Robbins opened conversation by asking me why I stopped working with corn, and my answer was that I had completed my part of the program. I had discovered the basic principles, had formulated them in 12 succinct statements, had invented a method of procedure, and had pointed out the important advantages the proposed program offered to agricultural practice—the assurance of greater yields and greater uniformity, sharper specialization to fit different regions, different climates, different soils, and the production of strains having to a superlative degree any desired chemical content or any other desired qualities. I had recognized for the first time in the history of science, I believe, the reciprocal relation between the deterioration due to inbreeding and the increased vigor due to crossing as the two aspects of a single phenomenon.

In an invitation lecture delivered at Göttingen, Germany, in July 1914, I had urged practical breeders of both plants and animals to make conscious use of hybrid vigor as a theretofore unrecognized source of economic gains. In that lecture I had proposed the word "heterosis" for the stimulating effect of the union of unlike germ cells—a word which has now been widely accepted in genetical textbooks. I had specifically urged the Agricultural Experiment Stations in the corn belt states to work out the problems necessary for the utilization of these principles and methods in practical corn production, pointing out that such problems of practical application lay outside the field of my own responsibility as staff member of the Station for Experimental Evolution, a laboratory established by the Carnegie Institution of Washington for research in basic biological science.

The solution of these practical problems came from two important and unanticipated innovations: Dr. Donald F. Jones, of the Connecticut Agricultural Experiment Station, proposed the double cross, and Henry A. Wallace formed the Pioneer Hi-Bred Corn Company to produce and sell to the farmers the hybridized seed corn. Both of these steps were absolutely essential to the success which has come to hybrid corn.

THE MEANING OF "HYBRID CORN"

I would like to explain now as briefly as I can just what we mean by hybrid corn, for in this expression we are using the word "hybrid" in a very special sense. Nearly everyone I meet these days has heard of hybrid corn, but it is infrequently that I find one who knows just what it is that makes it "hybrid corn." Earlier biologists and laymen generally used the word "hybrid" to mean the offspring from the mating of two parents belonging to different species, as, for example, in the universally known case of the mule produced by mating a mare to a jackass. In modern genetics the meaning of the word "hybrid" has been extended to all cases in which the parents differ in one or more hereditary traits. The result is that hybrids which were in the old sense relatively rare occurrences have come to be in the new genetical sense of almost universal occurrence in cross-breeding organisms. Only under systems of self-fertilization of hermaphroditic plants and animals do we find hybrids rare or nonexistent.

Although corn is a hermaphroditic plant, it self-fertilizes *naturally only occasionally*. The tassel at the top of the stem consists of the male flowers, which shed their pollen only when they are shaken by the wind. This pollen is so light that the slightest breeze will carry it away from the plant on which it is formed, thus making it mechanically difficult for the silks, or female flowers located about midway of the stem, to receive the plant's own pollen. This ensures that practically every plant in a field of corn as ordinarily grown is a hybrid in the modern genetical sense. This was the first basic fact that I discovered about corn, and it provided the subject matter for my first corn paper, "The composition of a field of maize," which I read before the American Breeders Association in Washington, D. C., in January 1908, and which was published later the same year in the yearbook of the Association. Keeping in mind this demonstration that practically every corn plant is a hybrid—what can we mean by the term "hybrid" corn that will differentiate it from the natural hybrids in the ordinary field? The distinctive feature of "hybrid corn," as the term is now generally used, lies in the fact that the *promiscuous* hybridization of the ordinary field of corn is replaced by *completely controlled* hybridization in the production of the hybridized seed corn from which the modern so-called "hybrid corn" is grown.

ECONOMIC IMPORTANCE OF HYBRIDIZING

The manner in which this control is established is very simple. Self-fertilization of the individuals in a hybrid progeny results, in the course of a few generations, in analyzing that hybrid into a group of pure lines which together may possess all of the hereditary elements present in the hybrid with which the self-fertilizations were initiated. If this original hybrid was very complex, each individual pure line derived from it may be unique in possessing a combination of hereditary elements different from that which characterizes each other pure line of the same derivation. When this stage of "purity" has been established by repeated self-fertilizations, we have in hand the elements for the production of various kinds of hybrid corn. Each kind of hybrid corn is produced by the definite combination of two, three, or four of these pure lines. Each given combination results in a hybrid which may then be compared with the hybrids produced by other definite combinations, and it is found by this comparison that some of these hybrids are superior in yield and/or desired qualities. When such a superior hybrid has been found, it can be maintained and perpetuated year after year in only one way, namely, by keeping the appropriate pure-bred strains (pure lines) carefully self-fertilized every year and by repeating the same combination of pure lines every year. These tedious and relatively expensive processes must be carried out with meticulous care and are too complicated to be handled by the ordinary farmer. For this reason the successful fruition of the hybrid corn program had to await the establishment of a new industry, that of the commercial corn hybridizers, led by the pioneering work of Henry A. Wallace in the establishment of his Pioneer Hi-Bred Corn Company. When the farmer wants to duplicate the splendid results he has had one year with hybrid corn, his only recourse is to return to the same hybridizer from whom he secured his seed the previous year and obtain again the same hybrid combination. He must pay twice as much for his seed corn than he was accustomed to pay for the best selected seed corn before hybrids became available, but this expensive seed corn adds only about $.50 to $.75 per acre to the former cost, and from the investment of this added $.50 to $.75 he increases his yield from that acre by about 25 per cent.

The hybrid seed industry has grown by leaps and bounds. Wallace's company now grosses more than $1,000,000 annually, and several still larger companies are approaching, if they have not already passed, a $10,000,000 annual turnover.

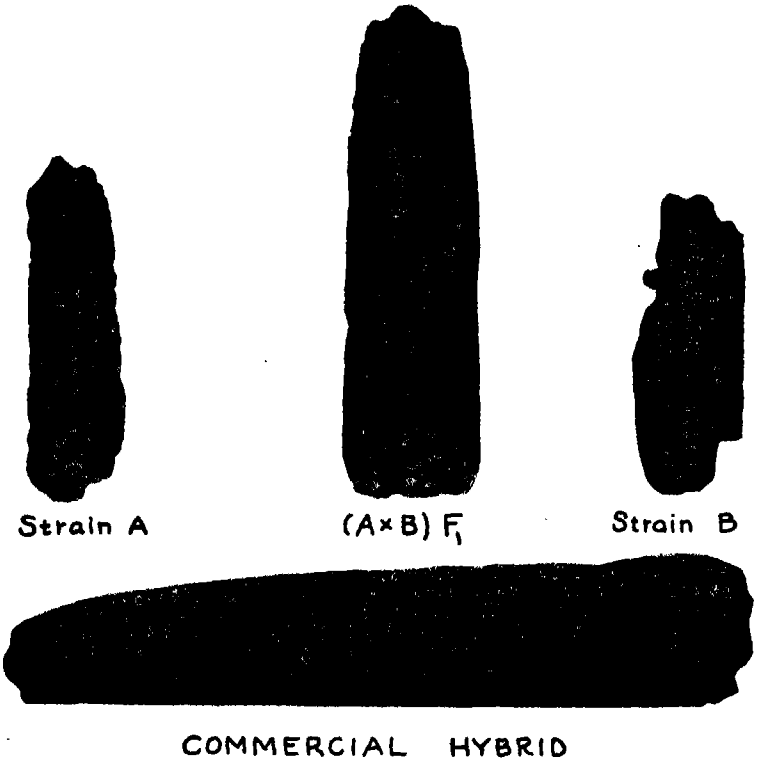


FIG. 1

Money Value of Hybridizing

The increase of 25 per cent on a crop amounting to $3,000,000,000 annually so far transcends our powers of comprehension that I prefer to make no statement of my own on the magnitude of the contribution which has resulted from the use of the new methods, lest I seem to be exaggerating. Instead, let me quote a recent authoritative statement made by Dr. Louis J. Stadler, of the University of Missouri, testifying before a subcommittee of the Committee on Military Affairs, of the U. S. Senate on the subject of Science Legislation. Dr. Stadler said in part:

> We know from the crop estimates of the United States

Department of Agriculture what fraction of the corn planted in each county was planted from hybrid seed, and we know from numerous and widely distributed field experiments the comparative performance of different strains of corn when grown side by side under identical conditions. In these experiments adapted hybrids consistently outyield the varieties of corn formerly grown, with an average margin of over 25 per cent.

This is an increase in yield which costs nothing except the added cost of producing the special type of seed and the added cost of harvesting a larger crop. In practice the seed is commonly produced by specialized seed growers, and the production and sale of hybrid seed corn has now become an industry with an annual turnover of about $75,000,000.

A conservative estimate of the increase in national corn production during the four years 1942–45, due to the partial use of hybrid corn, is 1,800,000,000 bushels. The money value of this increase on the basis of farm price per bushel is more than $2,000,000,000.

It is, therefore, no exaggeration to say, speaking in terms of the over-all national economy, that the dividend on our research investment in hybrid corn, during the war years alone, was enough to pay the money cost of the development of the atomic bomb.

Fig. 1 shows three ears of corn from my experimental crop of 1912, one ear each from my purebred strains, designated in my papers as Strains A and B and the hybrid produced by crossing A with B. These illustrate the truth of the old saying: "Great oaks from little acorns grow." Also shown in the figure is an ear of commercial hybrid corn of recent production from hybridized seed corn. It is a hybrid grown in 1940 from seed produced by the De Kalb Agricultural Association, one of the largest of the commercial hybridizers.

Obituary

Thomas Hunt Morgan

1866-1945

Thomas Hunt Morgan was an outstanding member of what may be called the heroic generation of American biologists—those whose work raised American biology to a position second to none among the countries of the world. This was the generation which, under the stimulus provided, in the first place, by Darwin's theory of evolution, second, by the rise of cell study in Central Europe, and third, by the sensational results of the experimental method of approach to problems of generation and development, set afoot that great series of researches in these related fields which made all general biology a really exact science, and which gave hope that ultimately the gap between it and the sciences dealing with inanimate matter could be bridged. With respect to both its versatility and the far-reaching nature of the conclusions convincingly established by a continuation of the lines of attack opened by his pioneer experiments, Morgan's work stands pre-eminent among the accomplishments of his generation.

Morgan's nature was iconoclastic: he took no stock in the pseudophilosophical mumbo jumbo rampant among many biologists even in the era immediately following Darwin, and would not let himself be overawed by the air of mystery surrounding such subjects as regeneration, embryology, heredity, and evolution. His approach was essentially of the type sometimes referred to (especially by those out of sympathy with it) as "mechanistic," although he did not commonly attempt to reduce his formulations all the way down to the level of the already-known physics and chemistry. As an ardent believer in, and practicer of, experiment, and again experiment, in whatever field, he belonged to that group which at the same time so abhorred what they termed "speculation" that they even distrusted the validity of the most essential lines of reasoning of Darwin himself, and he was a leader in that wave of skepticism whose participants "doubted the doubt till they doubted it out." Perhaps biological progress might have been even more rapid if the wheat had not been thrown away with the chaff, yet the end result of the skepticism, since it was combined with experiment and exact observation, was to lead some of this generation, and most of the next, to a vindication of the Darwinian essentials after all, and to an effective implementation of the Darwinian theory which joined it up with a scientific view of living matter in general. It is unusual to find a man who, like Morgan, is willing so to go back on his early preconceptions when the empirical facts demand it.

Starting out along morphological lines, Morgan, following Roux and Driesch, early went over to the experimental attack on problems of development, and his work helped to establish rational interpretations of such phenomena as the polarization of the frog's egg. His prolific work on regeneration pointed up a number of important problems in this field also and aroused much other American work on the subject, while his attempts to explain the phenomena of regeneration and development on a common basis, and in a rational way, as by the hypothesis of the influence of mutual pressures, though not finally confirmed, showed that there were grounds for hope of solutions being obtained here by experimental means. Turning to problems of evolution, he joined with those who called for more empirical facts, welcomed the results of the experimental breeders, and, after a more purely critical period in these lines (as in his *Evolution and adaptation* and *Experimental zoology*), set about the spadework in earnest himself. The "Mutation Theory," initiated by de Vries, seemed to him to provide a way out for the origin of species because he was distrustful of the theory of natural selection. Thus, when it appeared that the fruit fly, *Drosophila*, was amenable to breeding studies, as shown in the work of Castle, Moenkhaus, Lutz, and (in the Columbia laboratory itself) Payne, Morgan eagerly seized on this material for finding out the facts at first hand. Everyone knows of his remarkable assiduity in finding mutations, from about 1909 to 1912, and of the facts that they did not, individually, establish new species after all and did not (as he, following Darwin on this point, had thought they might) show a qualitative relation to the conditions under which they occurred, or a tendency to be repeated more often in a given direction after having once occurred. Undaunted by these seeming negatives, however, Morgan deflected the direction of his search and studied the method of their inheritance once they had occurred.

It was this reorientation of his attack, together with a concentration of attention upon those variants that could be recognized more definitely, which enabled Morgan to follow the transmission of sex-linked genes in *Drosophila* and so to show that this conformed with the chromosomal pattern which Miss Stevens had found cytologically in that organism. From this preliminary (which, after all, was more or less paralleled in other forms) Morgan passed on to what undoubtedly stands as by far his greatest contribution: the setting up of the genetic case for crossing over. This involved the obtaining of data which showed, first, that different genes connected with the same pair of chromosomes (the X) undergo interchange, and second, that they do so with various frequencies, all of them below that of random relations—that is, they are "linked." It involved, further, the recognition that these facts are just what is to be expected on the "chiasmatype" theory which had already been proposed by Janssens, especially if, as Morgan himself pointed out should be the case, genes further apart have more crossing over between them. This served as the forerunner to a multitude of researches by numerous workers, at first mainly on the *Drosophila* material, which have served to vindicate the crossing-over theory and along with it the chromosome theory of heredity in general.

That the early findings of Morgan were so quickly followed up and generalized upon was due in no small measure to his having opened the doors of his laboratory and, indeed, of his mind to a group of co-workers, already trained in the chromosome theory by Wilson, who chose entirely their own leads and who would not have had the opportunity to carry on freely in most European or even American laboratories. Had Morgan been more of an authoritarian and less willing to be merely an equal member of the group in discussions, the younger workers would not have had the opportunity they needed for the further development of the subject, and Morgan's own mind would not have become so opened to the full implications of the facts found in the *Drosophila* work as to have led him finally to agree that, after all, they lead inevitably back to a theory of natural selection, now on a more rational basis and provided with an elaborate mechanism for its operation. Morgan was won to this point of view only against his own very active opposition, yet it is to his enduring credit that he was finally willing thus to alter his whole viewpoint in accordance with the empirical facts. Having done so, he was able through the series of hammer blows of his successive expositions of the subject to persuade the world of the truth of this point of view. However much the story of the formative period of the *Drosophila* work may be rewritten and reappraised in the future, there must remain agreement in regard to the fact that Morgan's evidence for crossing over and his suggestion that genes further apart cross over more frequently was a thunderclap, hardly second to the discovery of Mendelism, which ushered in that storm that has given nourishment to all of our modern genetics.

H. J. MULLER

Indiana University

Clarence Erwin McClung

1870-1946

C. E. McClung died suddenly on 17 January 1946 at the age of 75. Thus, one more of that group of brilliant zoologists who appeared on the horizon of American science at the turn of the century has passed on. He was born at Clayton, California, on 5 April 1870, but spent most of his earlier years in Kansas, where he grew up, received his education, and became established in his professional career. As a boy he displayed an interest in chemistry and subsequently studied pharmacy at Kansas University, receiving the Ph.G. degree in 1892. After teaching chemistry and pharmacy at the University for a year, he entered the college and then continued in graduate work. He also pursued graduate studies for one semester under E. B. Wilson at Columbia University and for one summer with W. M. Wheeler at the University of Chicago. Kansas University awarded him the A.B. degree in 1896, the A.M. in 1898, and the Ph.D. in 1902.

Interest in zoology arose through contacts with S. W. Williston, who introduced young McClung to animal histology and vertebrate paleontology. At the suggestion of Prof. Wheeler he undertook a study of the spermatogenesis of *Ziphidium fasciatum,* a "long-horned" grasshopper. In this material "a peculiar nuclear element," which others working on different insects had considered to be a nucleolus, was shown by McClung to be a chromosome. Although not the first to discover that this element was distributed to one-half the spermatozoa, apparently he was the first to see the significance of this fact in relation to sex determination. This interpretation, first announced in 1901, brought him world-wide recognition and initiated a lifetime of researches on the chromosomes and their relation to taxonomy and evolution.

In addition to his numerous papers on chromosomes, Dr. McClung's publications reveal a wide range of interests including pharmacy, paleontology, microtechnique, photography, and a variety of educational and philosophical subjects. Interest in the microscope and in the techniques related to it resulted in the design of a "McClung Model" research microscope and in the publication of the *Handbook of microscopical technique,* prepared with the help of a group of collaborators.

As a teacher, Dr. McClung sought to develop the natural capabilities of each student. In the elementary course in zoology, which he taught at Kansas University, he introduced "unknowns" to arouse the spirit of inquiry which most young people possess but which is too often suppressed by current methods of college instruction. As editor of the *Journal of Morphology* from 1920 until his death, he labored to help authors, especially the younger ones, to appreciate the best methods of writing scientific papers.

Dr. McClung's keen intellect, genial personality, and administrative ability brought him many responsibilities both inside and outside the universities which he served. At Kansas University he was made chairman of the Department of Zoology in 1901 and curator of vertebrate paleontology in 1902, and he served as acting dean of the Medical School from 1902 to 1906. He was also chairman or member of many administrative committees.

In 1912 Dr. McClung was called to the University of Pennsylvania as director of the Zoological Laboratory. Here, through committee assignments and in other ways, he worked for progressive changes in curricula and improvements in facilities for graduate studies and research.

At the Marine Biological Laboratory, Woods Hole, Massachusetts, Dr. McClung became trustee in 1913, a member of the investigative staff in 1914, and served as chairman or member of the committees on new permanent buildings, endowment, the library, and the executive committee.

In 1917 Dr. McClung was made chairman of a zoology committee of the Division of Biology and Medicine of the National Research Council and in 1919 became the first chairman of the new Division of Biology and Agriculture, which he helped to organize. He was also a member of the Division of Educational Relations of the Research Council. He was the first president of the Union of American Biological Societies (1922–30), which, with other organizations, sponsored *Biological Abstracts,* and from 1925 to 1938 he served as president of the latter's board of trustees.

Various interests and responsibilities took Dr. McClung abroad. In the summer of 1924, accompanied by Dr. Schramm, then editor of *Biological Abstracts,* he toured Europe in the interests of this new abstracting service. The academic year 1927–28 was spent in travel, research, and writing in Europe. In 1930 he was the delegate of the U. S. Government, the American Philosophical Society, and the National Academy of Sciences at the International Congress of Biology at Montevideo. In 1933–34 he went to Japan as visiting professor at Keio University, Tokyo, returning through Europe. In 1939 he made a collecting trip to South Africa and completed a second trip around the world.

Among the executive offices held by Dr. McClung were also the following: president, Central Branch, American Society of Zoologists (1910), combined Zoological Society (1914), American Naturalists (1927), National Society of Sigma Xi (1917–21), Beta Beta Honorary Biological Fraternity (1936 onward); vice-president, Section F (Zoology), AAAS (1926). He was a member of the American Philosophical Society and of the National Academy of Sciences.

A degree of Doctor of Science was awarded to Dr. McClung by the University of Pennsylvania in 1940 and by Franklin and Marshall College in 1942. During 1940–41 he was acting chairman of the Department of Zoology at the University of Illinois, and in 1943 he became acting chairman of the Department of Biology at Swarthmore College.

D. H. Wenrich

University of Pennsylvania

Technical Papers

Occurrence of Mitotic Crossing-over Without Meiotic Crossing-over

GERMAINE LECLERC[1]
Department of Zoology, University of Rochester

The occurrence of crossing-over has been demonstrated not only during the meiotic cycle but also during mitotic multiplication of cells in certain plants and animals (*2, 6–9*). The purpose of the experiment to be reported here is to see if the gene c3G in *Drosophila melanogaster* which nearly eliminates meiotic crossing-over also suppresses mitotic crossing-over.

C3G is a recessive gene in the third chromosome (*5*). Externally it produces no visible effect in either homozygous or heterozygous constitution. However, it eliminates nearly all meiotic crossing-over in the first, second, and third chromosomes and causes frequent nondisjunction of chromosomes I and IV as well as the production of intersexes, supersexes, triploids, and numerous sterile eggs. It presumably acts by nearly eliminating meiotic pairing in the female, the nonsynapsed chromosomes being distributed at random without having undergone crossing-over (*3*).

Mitotic crossing-over can be studied by means of mosaic spots due to crossing-over in somatic cells ("somatic crossing-over"). The latter will result in groups of cells homozygous for genes carried initially in heterozygous condition in the developing zygote. Genes in the X-chromosome were chosen for the present study, and females carrying recessive sex-linked genes in heterozygous constitution were obtained. The genes had to be suitable to produce observable effects in small patches of cells on the surface of flies whenever the cells had become homozygous due to crossing-over. Genes meeting these requirements are y (yellow body color, 1, 0.0) and sn^3 (singed bristles, 1, 21.0). In order to obtain flies homozygous for c3G and heterozygous for the genes y and sn^3, two stocks were employed: (1) homozygous for the normal alleles of y and sn^3 and also homozygous for c3G (++;c3G), and (2) homozygous for y sn^3 and also homozygous for c3G (y sn^3;c3G). For the latter stock we are indebted to Miss Eva Rosenow (Mrs. Fred Sherwood). Flies of both stocks were crossed reciprocally, and the F_1 female offspring (y sn^3/++; c3G/c3G) were examined for the occurrence of mosaic spots. Since crossing-over occurs at the four-strand stage in somatic cells as well as in meiosis, yellow singed spots indicate crossing-over between the kinetochore and the sn locus, yellow spots result from crossing-over between the y and sn loci, and singed spots from double crossovers.

As a check on the ability of the observer to identify spots a control cross of y sn^3 females to wild-type males and the reciprocal cross were made. Spots due to somatic crossing-over were observed on more than 21 per cent of the F_1 females. Since c3G flies are indistinguishable from flies not containing this gene, contamination or errors during the building up or the keeping of c3G stocks do not automatically become obvious. Therefore, as a check on the purity of the c3G stock, crossover tests were made before and after the experiment. These tests confirmed the absence of crossing-over in all cases. The low viability of the stock and high percentage of nondisjunction in both chromosomes I and IV during the experiment also served as a check on the presence of c3G.

In spite of the presence of c3G which suppresses crossing-over in meiosis, not less than 22 per cent of the flies examined showed somatic spots due to mitotic crossing-over. This compares with a frequency of 21.5 per cent in the "control" (Table 1).[2] Therefore, the elimination of meiotic crossing-over is not associated with an effect on mitotic crossing-over in somatic cells of Drosophila females.

TABLE 1

	Flies examined	Flies with spots	Per cent flies with spots	Total no. of spots	Per cent spots	Description of spots		
						y sn	y	sn
Control	93	20	21.5	26	27.9	15	6	5
Experiment ...	71	16	22.5	18	25.8	13	4	1

The result reported is not entirely unexpected because (1) Friesen reported spermatogonial crossing-over in X-rayed males (thus, mitotic without meiotic crossing-over, since there is no crossing-over in the male); (2) Gowen (*4*), after X-raying c3G flies, found somatic spots (eye mosaics); (3) Stern (unpublished) saw regular pairing in the oögonial cells of homozygous c3G flies; and finally, (4) Dr. Jack Schultz permits me to quote him as having observed regular pairing in the salivary glands and in the endomitotic nerve cells of the ovary of homozygous c3G animals.

---

[1] The writer is gratefully indebted to Dr. Curt Stern for suggesting the experiment and for his advice and encouragement.

[2] Since these figures are much higher than those reported in other studies of the same somatic changes (*1, 7*), it might be mentioned here that though some of the spots involved as many as five hairs, many spots were determined on the basis of a single hair. Undoubtedly, however, differences between the genetic background of the flies used in different experiments also contribute to the variability of frequency of spots observed.

By themselves, however, these former results are not decisive, since in (1) and (2) they could have been attributed to special X-ray effects and since regular pairing in (3) and (4) does not necessarily signify crossing-over. Only some data on autosomal somatic crossing in untreated males (7) are of similar significance as the data reported here, which give evidence of mitotic crossing-over in untreated females homozygous for c3G.

References

1. AUERBACH, C. *Proc. roy. Soc. Edinb.*, 1945, **26**, 120.
2. FRIESEN, HEINRICH. *Bull. Biol. Med. Exp.*, 1936, **1**, 202.
3. GOWEN, JOHN W. *J. exp. Zool.*, 1933, **65**, 83.
4. GOWEN, JOHN W. *Science*, 1929, **70**, 358.
5. GOWEN, MARIE S., and GOWEN, JOHN. *Amer. Nat.*, 1922, **56**, 286.
6. MCCLINTOCK, BARBARA. *Genetics*, 1938, **23**, 315.
7. STERN, CURT. *Genetics*, 1936, **21**, 625.
8. STERN, CURT. *Amer. Nat.*, 1939, **73**, 95.
9. WITTINGHILL, MAURICE. *Genetics*, 1938, **23**, 300.

Linkage and Crossing-over Between Black Pigmentation and Susceptibility to Induced Fibrosarcoma in Mice[1]

LEONELL C. STRONG

Department of Anatomy, Yale University School of Medicine

Evidence has been published which indicates that germinal mutations have been induced in mice by chemical means. These germinal changes occurred in mice whose parents and grandparents had been injected subcutaneously with methylcholanthrene for a number of generations. More recently it has been determined that one of these germinal mutations (recessive brown pigmentation to dominant black pigmentation) has also apparently involved the genetic mechanism which determines, in part, susceptibility to fibrosarcoma induced at the site of methylcholanthrene injection. Thus, the black mutants possess a tremendously enhanced susceptibility to fibrosarcoma above the susceptibility possessed by mice of their ancestry or even their brown litter mates. Further unpublished evidence has shown that of the mice of the 15 inbred strains developed by the author and tested for susceptibility to fibrosarcoma, all, irrespective of genetic origin or relationship, that possess the black gene show a higher susceptibility to induced fibrosarcoma than any mouse of any of the strains possessing the brown gene. Thus, a linkage experiment is clearly indicated.

The F_1 from a cross between the original brown ancestral stock (NHO descent) and the black mutants possess the susceptibility of the black mutants (dominant inheritance). The F_1 generation consisted of 76 mice, all showing the dominant black. In the backcross generation to the recessive brown stock, 235 mice have been obtained and tested for susceptibility to induced fibrosarcoma. Of these, 121 were black and 114 brown (expected on Mendelian theory, a 1:1 ratio). The black backcross mice retain the susceptibility of the black mutants and the F_1's, whereas the brown backcross show the low susceptibility of the ancestral brown stock. Thus, linkage between black hair color and susceptibility to induced fibrosarcoma has been demonstrated.

The late survivors of the F_1 (that is, those mice living beyond 75 per cent of the total F_1's) show some degree of resistance, since it takes a longer time for them to develop fibrosarcoma at the site of injection. Therefore, if this tendency to greater resistance to fibrosarcoma is due to the loss of the hypothetical high susceptibility "gene" through the process of crossing-over, it ought to be possible to demonstrate this by the investigation of their descendants. This has been done, and when mice of one subline (of three separate ones tested) of the black mutant derivatives, suspected of possessing low susceptibility to induced fibrosarcoma even though they were black, were outcrossed to the ancestral brown stock, the F_1's (255 mice) showed the fibrosarcoma susceptibility of the resistant brown stock mice. A new black subline derived from these resistant F_1 black mice continued to show the low susceptibility of the brown mice.

The present evidence would indicate that on the "black" chromosome there is a gene that determines high susceptibility to induced fibrosarcoma; on the "brown" chromosome, a gene that determines low susceptibility or resistance to the same induced neoplasm. In the data reported here it appears that the process of crossing-over has occurred between the black gene and the S^{fs} (susceptibility to induced fibrosarcoma) gene. Thus, the evidence is accumulating that the intrinsic or genetic nature of resistance and susceptibility to induced fibrosarcomas is beginning to be indicated; that is, a mouse develops a fibrosarcoma *following the subcutaneous injection of methylcholanthrene* because it has a peculiar configuration in its genetic constitution determined by genes which apparently obey the same laws of Mendelian heredity (linkage and crossing-over) as the genes that determine hair pigmentation, etc. One of the genes, the S^{fs}, is on the same chromosome that carries the gene for black pigmentation.

---

[1] This experiment has been made possible by grants from The Anna Fuller Fund and The Jane Coffin Childs Memorial Fund for Medical Research.

Haploidy as a Factor in the Polymorphic Differentiation of the Hymenoptera

STANLEY E. FLANDERS
University of California
Citrus Experiment Station, Riverside

Polymorphism, or the existence within a species of two or more adult forms of the same sex, is characteristic of many insects. In the Hymenoptera, polymorphism appears to be an effect of nutritional differences which occur during ontogeny (*13, 14, 16*).

The degree of polymorphic differentiation apparently varies with the developmental stage in which differentiation is induced. Differentiation induced during the larval stage, as in the honey bee (*16*), and *Melittobia chalybii* (*14*), is much less marked than that induced earlier in development during the primordial germ cell stage, as is apparently the case in the alternating generations of the gall wasps (*Cynipidae*) (*7, 9*).

Polymorphism plays an important part in the economy of a species when it forms the basis of a social organization, as in the aculeate Hymenoptera and the Isoptera (*Termitidae*).

In the Hymenoptera, however, the occurrence of polymorphism is limited by haploidy, a phenomenon unknown in the Isoptera, in which the sexes are diploid and equally polymorphic (*10*). In the Hymenoptera only the female is normally diploid, and polymorphism is largely limited to that sex. This is not because haploidy in itself is inimical to polymorphism, for species exist in which polymorphism is limited to the haploid male (*1, 13*).

It would appear that the relatively low incidence of male polymorphism in hymenopterous species is an effect of the male not being subjected to the conditions which cause polymorphic differentiation or, if so subjected, of not being able to reach maturity.

Haploidy is known to be lethal in several species of parasitic Hymenoptera (*11, 12, 15*), nonpolymorphic as well as polymorphic. It is significant that haploidy appears lethal only in species which show a disinclination to oviposit before mating (*5*).

In most species that oviposit as readily before as after mating haploidy is rarely, if ever, a factor in the failure of the egg to hatch. It is evident, therefore, that haploidy may be lethal only if it is associated with some condition of the egg brought about by the disinclination to oviposit.

Most Hymenoptera are highly specialized in their selection of sites for the deposition of their eggs. Consequently, it is not surprising that in many species of Hymenoptera, particularly in those in which the female is long-lived, oösorption occurs if suitable oviposition sites are lacking (*4*). When the rate of egg deposition is relatively low, a relatively high proportion of the eggs deposited may be partially absorbed. In a mated female such eggs are more likely to be fertilized than eggs deposited rapidly and not subjected to the oösorptive process.

Whiting (*17*) has observed that in *Microbracon hebetor* more nonhatching eggs were obtained from females mated with related males than from females unmated or mated to unrelated males. The higher mortality of the eggs from the close-crosses in *M. hebetor* is reported by Whiting as due to the lower viability of the diploid individuals. Since it is quite possible that females mated with related males are more disinclined to oviposit than females mated with unrelated males, the former may deposit more partially absorbed diploid eggs than the latter. Such eggs may account for the polymorphism exhibited by inbred stocks of *Microbracon* (*6*).

In species in which the unmated female is disinclined to oviposit, the haploid male progeny are produced the greatest numbers when oviposition by mated females occurs at the maximum rate. It is then that the highest proportion of eggs escape fertilization and oösorption is at a minimum (*2*).

If the haploid hymenopterous egg, upon losing part of its content by absorption while in the ovariole, loses its capacity for hatching, it may regain this capacity by becoming diploid through fertilization. This probably would be necessary if polymorphic differentiation is determined by the partial absorption of ripe ovarian eggs (*8*).

In this connection it should be noted that in polyembryonic species it may be the mere addition of sperm to an egg that enables that egg to produce more embryos (*3*) than it would if unfertilized.

It is significant that in endoparasitic species—that is, species which place their eggs in position to absorb nutrient from the host—polymorphism appears to be limited to the haploid individual (*1, 13*). It is known in the case of the endoparasitic *Trichogramma semblidis* that polymorphic differentiation is determined by the kind of host.

Polymorphic individuals in species in which differentiation is determined by the partial absorption of the ripe ovarian egg (which is a point about midway in ontogeny) should be more strongly differentiated than the queen bee and worker and less so than the alternating generations of certain gall wasps. The oösorptive process apparently has a graduated effect on the eggs which would allow for the fullest expression of the polymorphic potentialities inherent in the germ plasm.

In the Hymenoptera, polymorphism finds expression commonly in diploid individuals, rarely in haploid individuals. In many, if not all, polymorphic species, under natural conditions, the production of diploid eggs greatly exceeds that of haploid eggs.

In social species the low incidence of male polymorphism may result either from the mortality of the partially absorbed unfertilized egg, from the fertilization of all the partially absorbed eggs deposited, or from the relatively small nutritional needs of haploid individuals.

References

1. Costa Lima, A. da. *Anais Acad. Brasil Cien.*, 1944, **16**, 73–78.
2. Flanders, Stanley E. *Ent. Soc. Amer. Ann.*, 1939, **32**, 11–26.
3. Flanders, Stanley E. *J. econ. Ent.*, 1942, **35**, 108.
4. Flanders, Stanley E. *J. econ. Ent.*, 1942, **35**, 283.
5. Flanders, Stanley E. *J. econ. Ent.*, 1943, **36**, 802.
6. Flanders, Stanley E. *Amer. Nat.*, 1943, **77**, 479–480.
7. Flanders, Stanley E. *Amer. Nat.*, 1945, **79**, 122–141.
8. Flanders, Stanley E. *Science*, 1945, **101**, 245–246.
9. Kinsey, Alfred C. *Waterman Inst. Sci. Res. Publ.*, 1929, **42**, 1–577.
10. Light, S. F. *Quart. Rev. Biol.*, 1942, **17**, 312–326.
11. McColloch, James W., and Yuasa, H. *J. econ. Ent.*, 1914, **7**, 219–227.
12. MacGill, E. I. *Proc. roy. Soc. Edinb.*, 1923, **43**, 51–71.
13. Salt, George. *Parasitology*, 1937, **29**, 539–553.
14. Schmieder, Rudolf G. *Biol. Bull.*, 1933, **65**, 338–354.
15. Schmieder, Rudolf G. *Biol. Bull.*, 1938, **74**, 256–266.
16. Wheeler, William Morton. *The social insects.* New York: Harcourt Brace, 1928. Pp. 378.
17. Whiting, Anna R. *Amer. Nat.*, 1940, **74**, 468–471.

Carcinogenic Substances From Pituitary Glands of Cattle

HENRY K. WACHTEL

Cancer Research Laboratories, Fordham University

The discovery of carcinogenic chemical substances suggested that in certain conditions analogous substances are produced within the organism and thus become responsible for cancerous growth.

Schabad (*12, 14, 15*) obtained a lipid extract from the liver of a patient who died of stomach cancer, and this extract, when injected into white mice, induced malignant tumor growth in some of the animals treated.

In further investigations Schabad, *et al.* (*4, 5*) prepared extracts of human livers from cancerous as well as noncancerous individuals. Of the white mice injected with these extracts about one-third died within the first few months of the experiment. A number of animals which lived to an age of more than 8 months following the first injection developed malignant tumors.

The findings of Schabad were confirmed by other investigators (*1–3, 13, 16–19*).

It must be added that Menke (*10, 11*) injected lipid extracts from human mammary cancers into white mice, and of 36 mice injected, 7 developed sarcomas after 7 to 14 months.

The above experiments indicate that carcinogenic chemical factors of a lipid nature are present in the cancerous as well as in the normal organism. Thus, the question arises as to the origin of these substances.

For investigation of this problem we employed our previous studies, which indicate that the pituitary gland is connected in a hormonal way with the development of cancer (*6, 7*). We therefore examined extracts of the pituitary gland for presence of carcinogenic hormonal factors.

EXPERIMENTAL

In our experiments fresh pituitary glands from cattle were freed from adjacent tissues and the anterior and posterior lobes of the gland carefully separated. One hundred posterior lobes or 50 anterior lobes were used for the preparation of each lipid extract.

The glands were extracted with acetone, ethyl ether, and alcohol, and the brownish oil obtained was suspended in sweet almond oil and injected subcutaneously into white mice of our own breeding. Our purebred strain of mice has a low incidence of spontaneous tumors (two mammary tumors in 1,700 mice).

The amount of extract obtained each time varied from 300 to 800 mg. The animals received 10 to 30 mg. each as a single injection, no difference in the effects being noted with variation of the dose within these limits.

Four extracts were prepared from the anterior pituitary, and 32 white mice were given a single injection of the extracts.

Seven mice died during the first 4 months of the experiment. Of the remaining 25 animals injected with the anterior lobe extracts, 9 developed malignant tumors: 4 females developed breast cancer (after 7, 7, 10, and 14 months), 1 male and 1 female developed carcinoma at the site of injection (after 13 and 6 months), 1 male and 2 females developed liver cancer (after 8, 9, and 8 months).

Of the 16 animals which died without developing tumors, the individuals survived as follows: 3 for 7 months, 3 for 8 months, 2 for 10 months, 1 for 11 months, 2 for 12 months, 3 for 13 months, 1 for 14 months, and 1 for 19 months.

Of the four extracts prepared from the anterior lobe, one caused no malignancy in the animals injected, while another provoked 5 various tumors in 6 injected mice. The remaining two extracts provoked malignancy in 20.6 per cent of the animals injected.

Five extracts were prepared from the posterior lobe of the pituitary gland, and 35 animals were given a single injection of the extracts.

Twelve mice died during the first 4 months of the experiment. Of the remaining 23 animals injected, 9 developed malignant tumors: 3 females developed breast carcinoma (after 5.5, 16, and 19 months), 1 female and 2 males developed lung carcinoma (after 18, 16, and 22 months), 1 male developed liver carcinoma (after 11 months), and 2 males developed sarcoma at the site of injection (one lymphosarcoma after 9 months, and one spindle cell sarcoma after 11 months).

Of the 14 animals injected and dying without developing tumors, the individuals survived as follows: 1 for 9 months, 2 for 11 months, 3 for 13 months, 3 for 15 months, 1 for 16 months, 2 for 17 months, 1 for 19 months, and 1 for 22 months.

Of the five extracts prepared from the posterior lobe, one caused no malignancy in the animals injected, while another provoked 3 breast cancers in 4 mice injected. The remaining three extracts provoked malignancy in 25.4 per cent of the animals injected.

DISCUSSION

In our experiments lipid extracts prepared from the beef pituitary and injected into white mice provoked the growth of malignant tumors in a number of the animals injected. Extracts from the anterior lobe as well as extracts from the posterior lobe of this gland were equally active, provoking malignancy in 26.8 per cent of the animals used in the experiments.

The malignant tumors usually developed in organs at a distance from the site of injection, only 4 animals (of 18) developing cancer at that place.

The malignancy appeared in various histological types including carcinoma as well as sarcoma.

The only difference in the carcinogenic activity noted between the extracts of the anterior lobe and those of the posterior lobe of the gland involves the time of development of tumors after injection. The tumors developed earlier after injection of the anterior lobe extracts than after injection of extracts of the posterior lobe. Of the 9 cancers observed in each of the two experimental series, 8 developed during the first 10 months of the experiment in the series injected with anterior lobe extracts. During that period of time only 2 cancers developed in mice injected with the posterior lobe extracts. The calculated average period of time necessary for the development of the tumor is: for anterior lobe extracts, 9.3 months; for posterior lobe extracts, 14 months.

Assuming that the same chemical agent causes malignancy after injection of the anterior or posterior lobe extracts, an additional factor which accelerates the development of tumors must be present in the extracts prepared from the anterior lobe of the gland. The lipid growth-accelerating hormone isolated by Lustig and Wachtel (*8, 9*) from the anterior pituitary lobe can be considered correlated with the causation of this phenomenon as it markedly increases the growth rate of transplantable mice tumors.

The differences in the degree of the carcinogenic activity observed with different extracts prepared from both lobes of the pituitary gland are still to be explained. Many factors may be operative, e.g. differences in response of animals treated, differences in dosage, or imperfection in the method of extraction. It is also probable that the inactive or feebly active extracts include an unknown factor which renders the carcinogenic component ineffective. If that factor is lost during the extraction, the carcinogenic activities of the extract attain full opportunity for their development. Further experiments for clarification of this subject are in progress.

The histological diagnosis of the tumors was verified by Dr. Francis Carter Wood, to whom we are indebted for his cooperation.

SUMMARY

Lipid extracts from the pituitary gland of cattle were prepared which, when injected into a pure strain of white mice, caused development of malignant tumors in 26.8 per cent of the 67 animals injected, which corresponds with the numerical results obtained by investigators working with human liver extracts. Evidently the carcinogenic power of these lipid extracts is low. The tumors developed chiefly in organs at a distance from the site of injection, exhibiting various histological types including carcinoma as well as sarcoma. The tumors developed at an earlier date after injection of extracts from the anterior lobe as compared with those developing after injection of the posterior lobe extracts, the average period of time necessary for their development being 9.3 months for the anterior lobe extracts and 14 months for posterior lobe extracts.

References

1. DES LIGNERIS, M. J. A. *Amer. J. Cancer*, 1940, **39**, 489.
2. HIGIER, I. *Amer. J. Cancer*, 1940, **39**, 496.
3. HIGIER, I. *Science*, 1941, **93**, 262.
4. KLEINENBERG, H. E., NEUFACH, S. A., and SCHABAD, L. M. *Amer. J. Cancer*, 1940, **39**, 463.
5. KLEINENBERG, H. E., NEUFACH, S. A., and SCHABAD, L. M. *Cancer Res.*, 1941, **1**, 853.
6. LUSTIG, B., and WACHTEL, H. *Klin. Wschr.*, 1938, 163.
7. LUSTIG, B., and WACHTEL, H. *Protoplasma*, 1939, **32**, 556.
8. LUSTIG, B., and WACHTEL, H. *Nature, Lond.*, 1939, **143**, 602.
9. LUSTIG, B., and WACHTEL, H. *C. R. Soc. Biol. Paris*, 1939, **132**, 224.
10. MENKE, J. F. *Science*, 1940, **92**, 290.
11. MENKE, J. F. *Cancer Res.*, 1942, **2**, 786.
12. NEUFACH, S. A. *C. R. Soc. Biol. Paris*, 1937, **124**, 616.
13. SANNIÉ, CH., TRUHAUT, R., and GUERIN, P. *Bull. Ass. l'étude cancer*, 1941, **29**, 106.
14. SCHABAD, L. M. *C. R. Soc. Biol. Paris*, 1937, **124**, 218.
15. SCHABAD, L. M. *C. R. Soc. Biol. Paris*, 1937, **126**, 1180.
16. STEINER, P. E. *Science*, 1940, **92**, 481.
17. STEINER, P. E. *Amer. J. Path.*, 1941, **17**, 667.
18. STEINER, P. E. *Cancer Res.*, 1942, **2**, 425.
19. STEINER, P. E. *Cancer Res.*, 1943, **3**, 385.

Science Legislation

Statement Concerning S. 1850

Committee Supporting the Bush Report

On behalf of the 5,000 scientists and others who signed or endorsed our letter to the President dated November 24, 1945, we appeal to the Congress to enact S. 1850, the National Science Foundation Bill introduced February 21, 1946, by Senators Kilgore, Magnuson, Johnson, Pepper, Fulbright, Saltonstall, Thomas, and Ferguson, and recently reported out with approval by a majority of the Senate Committee on Military Affairs. (*Science*, 1946, **103**, 192; 382.)

For the reasons stated in the Bush Report and in the Report on Science Legislation of the Committee on Military Affairs, we are in favor of Federal support for scientific research and education. We are in favor of a National Science Foundation. We are satisfied that, given appointments by the President to the National Science Board solely on the basis of demonstrated capacity and fitness, the Foundation described in S. 1850 will promote and protect the interests of science and will thus serve the public welfare.

While S. 1850 is a compromise, it is a compromise on which most scientists have agreed. Most of the principles for which this Committee has consistently stood have been accepted. Thus there is provision for a strong National Science Board. Though the Administrator will be appointed by the President, the President must consult with and receive the recommendations of the National Science Board concerning the appointment. And the Administrator must consult and advise with the Board on all matters of major policy, program, or budget. The Board has the power to make recommendations to the President and to the Congress independently of the Administrator. The advice and approval of the Board are required for appointment to the Divisional Scientific Committees, the chairmen of which will serve as members of the Board. Except in the case of National Defense, there is no provision for *ex officio* appointments either to the Board or to the Divisional Committees. The Foundation will be endowed with powers sufficient to initiate and carry out an effective program in aid of scientific research and education.

In endorsing S. 1850 and appealing for its prompt enactment, we recognize that many scientists doubt the wisdom of (a) the inclusion of the social sciences in *this* legislation, (b) the provisions affecting the Government's patent policy, and (c) the arrangement for mandatory geographical distribution of funds to state-supported and land grant colleges. While many would be better satisfied if these provisions were dropped, protracted delay or failure to enact this legislation would be far more prejudicial to the public interest than the inclusion of the provisions objected to.

We believe that the creation of a National Science Foundation to support fundamental scientific research and the education of scientists is of the utmost importance for the health, security, and welfare of the nation. Moved by this conviction and recognizing the public responsibility of men of science in these matters, we have, to the full extent of our ability, endeavored to aid the Congress in the formulation of workable legislation. Believing the matter to be of great urgency, we recently joined with other groups in an appeal to the Chairman and members of the Senate Committee on Military Affairs to report a bill on which the majority of scientists could agree. S. 1850 is the result. We endorse this bill and appeal now to the Congress as a whole to create a National Science Foundation by the enactment of S. 1850 before the end of the present session.

Signatories of the Statement which was mailed to the President and the Congress, 23 April 1946

Isaiah Bowman, *Chairman*, Roger Adams, William P. Anslow, Jr., Boris A. Bakhmeteff, G. W. Beadle, Francis G. Blake, D. W. Bronk, William B. Castle, Alfred Chanutin, Walter C. Coffey, Robert E. Doherty, Edward A. Doisy, L. A. DuBridge, F. Malcolm Farmer, Herbert S. Gasser, Ernest Goodpasture, Farnham P. Griffiths, R. F. Griggs, C. P. Haskins, A. C. Ivy, Chauncey D. Leake, E. M. MacEwen, Charles E. MacQuigg, H. L. Marshall, C. S. Marvel, J. S. Nicholas, Alton Ochsner, J. Hugh O'Donnell, Walter W. Palmer, Linus Pauling, A. N. Richards, Homer W. Smith, Kenneth B. Turner, James J. Waring, Bethuel M. Webster, and Lewis H. Weed.

The AAAS Council vote, authorized at the St. Louis meeting, resulted in a clear majority supporting S. 1850; the vote was 223 to 10. This is the time for action. If you favor S. 1850, telegraph or write to *your* Senator now! Mention The National Science Foundation and the number, S. 1850.

News and Notes

J. Robert Oppenheimer, professor of Physics in the University of California, has returned to Berkeley. He will resume his regular teaching duties on the Berkeley campus at the start of the fall semester. He hopes, as in the past, to act as a consultant to the California Institute of Technology. Dr. Oppenheimer has been on leave of absence since July 1942 and served as director of the Los Alamos Atomic Bomb Laboratory, at Los Alamos, New Mexico, from its inception until after the termination of the war. For the past few months he has worked in Washington, as a member of the Board of Consultants to the State Department, which has recently issued a report on the international control of atomic energy. (See *Science*, 1946, **103**, 451.)

Dr. Alpheus W. Smith, dean of Ohio State University's Graduate School and chairman of the University's Department of Physics and Astronomy, will retire during the coming summer. He has held both positions since 1939 and has been a member of the University's faculty for 37 years. Dr. N. Paul Hudson, who has been professor and chairman of the Department of Bacteriology since 1935 and who was professor of bacteriology at the University of Chicago from 1930–1935, will become the new dean of the Graduate School. Dr. Harald H. Nielsen, who has been on the physics faculty of Ohio State University since 1930, will become the new chairman of the Department of Physics and Astronomy.

Byron N. Cooper, formerly of the Virginia Geological Survey and more recently on the staff of the U. S. National Museum, has been appointed head of the Department of Geology at Virginia Polytechnic Institute, Blacksburg. He succeeds Roy J. Holden, who died last December. Dr. Cooper assumed his new duties on 1 April.

Charles A. Doan, dean and director of medical research, Ohio State University College of Medicine, delivered the Fifth Edwin R. Kretschmer Memorial Lecture on Friday evening, 26 April, at the Palmer House before the Institute of Medicine of Chicago. His subject was "Marrow Hematopoiesis (Synthetic Folic Acid) and Splenic Hematopenia: Experimental and Clinical Studies."

Willis H. Johnson, professor of biology at Stanford University, has been appointed professor of zoology and chairman of the department at Wabash College beginning September 1946. Dr. Johnson recently returned to Stanford after seven months service with the Army Educational Program at Shrivenham, England, and Frankfurt, Germany.

William R. Duryee, formerly assistant professor of biology at New York University, has been appointed technical associate, Committee on Growth, National Research Council. He was recently retired from the Army with the rank of major, after five years in the 27th Division and the Office of the Surgeon General. He was chief of the publications section, Training Division, SGO.

Sir Wallace Akers is resigning from his post as director of atomic bomb research at the Department of Scientific and Industrial Research. After a holiday, he will resume his duties on the board of Imperial Chemical Industries, Ltd.—*The Times* (London).

Dr. John P. Gillin, associate professor of anthropology at Duke University since 1941, has been appointed professor of anthropology and research professor in the Institute for Research in Social Science, University of North Carolina, Chapel Hill, effective 1 September 1946.

Dr. George O. Sharp, formerly of the University of Iowa and the American Medical Association Chemical Laboratories, has recently accepted a position with The Wm. S. Merrell Company as assistant chief chemist.

Dr. Benjamin J. Lazan, vice-president and chief engineer of the Sonntag Scientific Corporation of Greenwich, Connecticut, has been appointed associate professor of metallurgy and director of the Materials Testing Laboratory in the College of Applied Science, Syracuse University. He joined the University faculty on 1 May 1946.

Prof. Egidio Meneghetti, director of the Department of Pharmacology and rector of the University of Padova, continued his research activity more or less normally until 1943, when, with the whole staff of his Department and the majority of the university students and many of the professors, he started active "underground" work. Various inspiring papers of Prof. Meneghetti, who became leader of the underground and later of the armed revolt, have been collected in a volume entitled *Scritti clandestini* (Zanocco, Padova, 1945). Among the 33 members of the university who lost their lives were: Prof. Mario Todesco; Dr. Giovanni Carli and Dr. Otello Pighin, assistant professors in the School of Engineering; Dr. Angelo

Curiel, assistant professor at the Faculty of Sciences; and Dr. Matteo DeLuca, assistant professor at the Faculty of Medicine. Drs. Aldo Cestari and Benigno, also members of the Department of Pharmacology, were arrested by the Nazis, while Dr. Lanfranco Zancan, from his hiding place, gave a valuable contribution to the underground work.

The Department is now starting to work and is in need of books, reprints, and periodicals.

Elton J. Wood, of the Research Department, Radio Corporation of America Laboratories, Princeton, New Jersey, addressed the Philadelphia Science Teachers Association on 28 March on "Phosphors and Their Applications in Electronics." The meeting was held in cooperation with Schoolmen's Week at the University of Pennsylvania.

Dr. Arnold L. Soderwall has been promoted from instructor in zoology to assistant professor of biology at the University of Oregon.

Dr. Charles D. Coryell, of the Clinton Laboratories at Oak Ridge, Tennessee, has been appointed professor of chemistry at the Massachusettts Institute of Technology.

Announcements

The staff of the summer course in embryology of the Marine Biological Laboratory, Woods Hole, Massachusetts, has undergone several changes. Dr. Viktor Hamburger, of Washington University; Dr. W. W. Ballard, of Dartmouth College; and Dr. Jane Oppenheimer, of Bryn Mawr College, have resigned from the course staff. The present staff consists of: Dr. Howard L. Hamilton, of the State University of Iowa; Dr. John A. Moore, of Barnard College; Dr. Albert Tyler, of the California Institute of Technology; and Dr. Donald P. Costello, of the University of North Carolina, instructor in charge of course.

The Central Engineering Laboratory, established by the Government in the Towne Scientific School of the University of Pennsylvania for wartime research and development, has been converted into a University of Pennsylvania Thermodynamics Research Laboratory with a shift of emphasis toward fundamental research in thermodynamics, it has been announced by Dr. George Wm. McClelland, president of the University.

Under its new name it will continue to be housed in the Towne School on the University campus and will be maintained under contract with the Navy Department Bureau of Ships as a focal area of fundamental research designed to benefit both governmental and private agencies.

The Central Engineering Laboratory was established early in 1943 under a contract between the University and the Office of Scientific Research and Development, the latter appropriating nearly $1,000,000 for its work.

Possessing exceptionally diversified and extensive facilities for the production of liquid air, liquid oxygen, and liquid nitrogen, the physical plant of the Laboratory occupies 10,500 square feet of floor space in the Towne School, and by June 1947 will have been expanded by almost 10,000 square feet of additional space.

The Thermodynamics Research Laboratory is at present operating under 18 approved task orders, the term applied by the Navy to approved research authorizations, and several more are being considered for approval. There are 52 persons now engaged in its activities, the group including two linguists who translate seized German documents concerned with oxygen production.

"The program of the new laboratory places greatest emphasis on fundamental research," Dr. John A. Goff, dean of the Towne School, stated. "Its principal objective is to fill important gaps in our knowledge of the thermodynamic properties of substances involved in engineering processes and to apply this knowledge to the analysis of such processes as a necessary means for improving them. A corollary objective is the building of a strong program of graduate study and research in the thermodynamics and related fields to which the armed services may send selected officer personnel for advanced training. At the same time the program also calls for moderate activity along developmental lines to the extent that it makes use of the unique facilities of the laboratory not presently available elsewhere. Thus, provision has been made for cooperation with industry in the investigation of practical problems to which the facilities of the laboratory are especially adapted. The work of the new laboratory will be integrated with the Towne School's regular program of instruction, and to that end a number of members of the school's instructional staff are devoting substantial portions of their time to research in the laboratory as project leaders. A particularly significant development also has been the appointment of an advisory committee of outstanding scientists and engineers who will be active in long-range planning and direction of the laboratory's program."

Serving on that advisory committee, Dr. Goff revealed, are Earl P. Stevenson, president of Arthur C. Little, Inc., Cambridge, Massachusetts; Commodore R. V. Kleinschmidt, USNR (Retired); Lt. Cdr. Ashton T. Scott, Navy Department Bureau of Ships; Prof. Gerhard Herzberg, Yerkes Observatory, University of Chicago; Dr. Frederick D. Rossini, National

Bureau of Standards; Prof. Frederick G. Keyes, Massachusetts Institute of Technology; Prof. Maxwell Gensamer, Pennsylvania State College; and Dr. Hiram S. Lukens, Towne Scientific School.

The 50th Annual Meeting of the Michigan Academy of Arts and Letters was held in Ann Arbor on 12 and 13 April 1946. Alexander G. Ruthven, president of the University of Michigan, and Alfred L. Nelson, president of the Academy, gave the addresses at the 50th Anniversary Dinner on Friday evening, 12 April.

Among the sections which presented programs at this meeting were those on anthropology, botany, forestry, geography, geology and mineralogy, mathematics, psychology, sanitary and medical science, sociology, and zoology.

The Biological Laboratory, Cold Spring Harbor, is offering a course for research workers, to be given by Prof. Max Delbruck, of Vanderbilt University. The course is designed to acquaint scientists with some of the techniques used in research with bacterial viruses and with recent results of such work. It will be held from 15 July to 2 August.

The New York Hospital, Westchester Division, announces the establishment of a Department of Psychology, according to Clarence O. Cheney, medical director. Edward I. Strongin has been appointed head of the Department, which will be engaged in a systematic research program in addition to providing clinical psychological services. Arthur L. Benton has been appointed attending psychologist.

A position of assistant psychologist has been created and is at present open. Miss Ann Kennard has been appointed psychological interne. Both of the latter positions provide an opportunity for pursuing graduate work in New York City. Interested individuals are invited to write to Dr. Cheney concerning this vacancy.

Dr. Strongin has just returned to civilian life after almost three and one-half years in the Army as classification officer and aviation psychologist, and Dr. Benton has just returned to civilian life after more than four years in the Navy.

The American College of Dentists has authorized the following grants-in-aid for research for the period 1 July 1946 to 30 June 1947:

To H. B. Hunt and C. A. Heppert, of Michigan State College, is given the sum of $500 for a continuation of their work on the inheritance of dental caries in rats.

To Morris Steggerda, Hartford Seminary Foundation, Hartford, Connecticut, is given the sum of $500 for a study of the incidence of dental caries and the eruption time of teeth of various racial groups located in Africa, India, China, and Latin America.

The Association of Southeastern Biologists held its Seventh Annual Meeting on 19 and 20 April 1946 at the University of South Carolina, Columbia. This was the first meeting of the Association since 1942. Dr. Mary Stuart MacDougall, Agnes Scott College, is president of the Association, and Martin D. Young is secretary-treasurer.

The National Analysts, Inc., of Philadelphia, a complete marketing and research organization, announces the opening of its Washington Branch under the direction of Mrs. W. Charlotte Ewell, 203-A Stoneleigh Court; 1025 Connecticut Avenue, N. W.

The American Society for Horticultural Science announces the award of the Leonard H. Vaughan Memorial Award in Horticulture to Dr. V. T. Stoutemyer, U. S. Plant Introduction Garden, Glenn Dale, Maryland, for his paper on "The influence of changes in molecular configurations of several naphthyl growth substances on the rooting responses of cuttings" (*Proc. Amer. Soc. hort. Sci.,* Vol. 44), and to Dr. P. W. Zimmerman and Dr. A. E. Hitchcock, of the Boyce Thompson Institute for Plant Research, for their paper, "Substances effective for increasing fruit set and inducing seedless tomatoes" (*Proc. Amer. Soc. hort. Sci.,* Vol. 45).

This award is made each year through the generosity of the Vaughan Seed Stores of Chicago, Illinois, in memory of Leonard H. Vaughan. One award is made in floriculture and one in vegetable gardening, each for $500.

Clinical and research activities of the Clinic of Child Development, School of Medicine, Yale University, were depicted in a documentary film, the January issue of *The March of Time.* The film pictures a wide range of infants and preschool children, and is sound scored with dialogue and commentary.

Hitherto secret methods of flying training, employed by the RAF to meet a wartime emergency, proved so successful that they are being adopted as standard throughout the RAF and Dominion Air Forces. The methods were demonstrated at the Empire Central Flying School at Hullavington, Wiltshire, on 20 March, according to *The Times,* London.

The problem of night-flying training was solved by developing a combination of light-absorption filters which isolate the wave lengths of sodium light, which thus remains visible through otherwise dark filters.

The use of these filters has been developed in two ways to meet different requirements. To gain experience of "night" landing in daylight the pupil pilot wears filter goggles through which he can see nothing but the sodium flarepath on the airfield and the aircraft instruments, which are also sodium-lit. The instructor, sitting at his side without goggles, can, of course, see everything clearly. For training in instrument flying what is known as the two-way method is employed. Simple complementary color filters of blue and amber cut off the light in two stages. The windows of the cockpit are covered with the amber filter and the pupil-pilot wears blue goggles. The instructor has almost normal daylight vision through the amber windows, but the pilot can see only the sodium-lit instruments.

In both these methods of training the degree of "darkness" can be varied by the intensity of the filter used, so as to simulate conditions ranging from dusk to starlight, bright moonlight, and a very dark night.

The Radiolocation Convention, held at the Institution of Electrical Engineers, Savoy Place, London, 26–28 March, had an attendance of approximately 1,000. An attempt was made to review the developments in the field of radiolocation during the last six years. Those invited include delegations from eight other countries—Canada, the United States, France, Russia, Poland, Norway, Holland, and Switzerland.

The convention was opened by John Wilmot, Minister of Supply and Aircraft Production, P. Dunsheath, president of the Institution of Electrical Engineers, presiding.

Mr. Wilmot said he thought that only one other wartime development, penicillin, had as many possibilities for benefiting humanity as radar.

The opening session was also addressed by F. B. Llewellyn, president of the Institute of Radio Engineers of America, who said it was possible that radar was the best example of cooperative technical effort that the world has ever known. As radar had served during the war, so it could also serve during the peace.

Sir Robert Watson-Watt, speaking on the British contribution to the evolution of radiolocation, said it would be foolish to claim priority in the inception of radar for either Britain or America. The work done before the autumn of 1940 was completely independent in the two countries, while the work done thereafter was completely interdependent.

Every radar-equipped combat aircraft, ship, gun, and searchlight was, after every offsetting factor had been allowed for, much more than doubled in effectiveness by its radar aids.—*The Times* (London).

Southern Methodist University has announced a gift of $1,000,000 from Mrs. W. W. Fondren of Houston, Texas, for the construction of a building for the natural sciences. The Fondren School of Science will be housed in the building, which will include the Departments of Physics, Biology, Chemistry, Geology, and Geography.

The American Anthropological Association, at its annual meeting on 28 December adopted the following resolutions:

1. That the appropriate United States authorities be apprised of the strong opinion of the American Anthropological Association that scientific documents and specimens and works of art, legitimately acquired in the first instance by public institutions in enemy countries, be not made subject to seizure or to alienation by the United States as reparations and that as soon as possible such materials be restored to the institutions originally housing them.

2. That the American Anthropological Association, constituted of scientists interested in the study of human nature and society, recognizes the responsibility of anthropologists to study the effects of the discovery of the use of atomic energy, and to participate actively with other scientists in efforts to make appropriate social inventions to guard against the dangers and utilize the promise inherent in atomic use.

Dr. Frederick V. Hunt, associate professor of physics and communication engineering, who was director of Harvard's Underwater Sound Laboratory during the war, has been named chairman of a new department, Engineering Sciences and Applied Physics.

Several faculty groups now giving instruction in electronics, communication engineering, applied mathematics, acoustics, metallurgy, and mechanical engineering will be merged as a nucleus for the new department, which has been allotted $2,000,000 from the McKay Endowment.

Insect pests develop relative immunity to poisons by evolving new strains, presumably through normal processes of evolution. This is one of the chief reasons why the codling moth has remained a pest of apple orchards throughout the United States for more than a century, according to Dr. B. A. Porter, of the Department of Agriculture, in a report just issued by the Smithsonian Institution.

This insect is familiar everywhere. About 40 investigators, employees of federal and state governments, devote their entire time to studying means of combating it. The chief means used is that of spraying trees with lead arsenate. Yet it seems impossible to eliminate the pest, and from year to year it seems about as abundant as ever.

Recent experiments have shown, Dr. Porter says, that moth larvae from well-sprayed orchards show much greater ability to survive lead arsenate than those from poorly sprayed orchards, indicating the phenomenon of evolution in the survival of the fittest.

"The evidence indicates," he continues, "that, instead of remaining constant and static while the evolution of control measures was going on, the codling moth as a species has undergone considerable adaptation or evolution on its own account in the direction of greater ability to survive in the presence of insecticides. The segregation of resistant strains, together with certain practices on the part of the fruit industry, have permitted the insect to maintain its position as the most seriously destructive pest of the apple, in spite of the development of control by insecticides to a high degree of efficiency.

"The codling moth is only one of several insect pests known to have undergone development in this general direction, and many other insects may be developing in a similar way but at a slower rate."

The active participation of all botanists in the Southeast was made the goal of the Southeastern Section of the Botanical Society of America at a luncheon meeting of the section on 28 March in St. Louis, attended by members and visitors representing 13 institutions and 7 states in the area. The section chairman, Orland White, presided, and S. L. Meyer acted as secretary in the absence of Dr. Hunt; John Karling, secretary of the Botanical Society, was a visitor. New officers were chosen, who will determine the time and place for a spring or summer meeting of the Southeastern Section. They are L. R. Hesler, University of Tennessee, chairman; John N. Couch, University of North Carolina, secretary; and Velma Matthews, Coker College, Hartsville, South Carolina, and Ruth Schornherst, Florida State College for Women, Tallahassee, members of the Activities Committee.

A committee of three members of the American Association of Physics Teachers has been formed to assist in the improvement of the teaching of physics to premedical students and students of biology, following a recommendation from the Scientific Advisory Committee of the Baruch Committee on Physical Medicine.

The efforts of the committee are to be directed along two lines: (1) to assemble and make available to teachers of the first course in college physics illustrative material from biology and medicine which will show physical principles at work in biological processes and physical principles applied in the study of biological processes; (2) the planning of a second course in physics for students of biology and premedical students.

The committee requests those biologists, physicists, and physicians interested in this project who have suggestions for content to correspond directly with LeRoy L. Barnes, Rockefeller Hall, Ithaca, New York, chairman. Other members of the committee are Lester I. Bockstahler and Louis A. Strait.

A project in internal medicine at the New York Hospital has been announced by Cornell University. Designed to deal clinically and experimentally with psychosomatics, the project has three main objectives: (1) to develop a practical method for dealing with ambulatory clinic patients who suffer from symptoms related to their emotional states and life situations; (2) to engage in experimental study of the mechanisms involved in illness of this nature; and (3) to train especially able young physicians in experimental methods and to develop a critical psychosomatic approach to the care of the sick. Approximately half of the time will be spent in the diagnosis and management of patients, and the remainder in research dealing mainly with mechanisms underlying symptoms.

The project will be directed by Dr. Harold G. Wolff, with the assistance of an internist, Dr. Stewart Wolf; a psychiatrist, Dr. Herbert S. Ripley, Jr.; and six fellows. Fellows will be appointed for a period of one year with the expectation of serving for two or more. Their salary for the first year will be $2,500. Candidates for fellowships should have at least two years training in internal medicine and give evidence of a psychiatric orientation. They need not have had experience in research but must have a serious interest in investigation, energy, and curiosity.

Prospective candidates should arrange for a personal interview through Dr. David P. Barr, Professor of Medicine, The New York Hospital, 525 East 68th Street, New York City.

The Hematology Research Foundation, Chicago, invites applications for the Ruth Reader Fellowship for research in blood diseases. The value of this fellowship is $1,500 for one year. Applications must be submitted no later than 1 June to Dr. Ludwig Hektoen, 21 West Elm Street, Chicago, the chairman of the Medical Advisory Council for the Foundation. The Council will choose the applicant and the institution in Chicago.

Meetings

The American Association of Physics Teachers, in cooperation with the Society for the Promotion of Engineering Education, will hold a meeting at St. Louis, Missouri, 20–22 June 1946. Headquarters for this meeting and its sessions will be the Jefferson Hotel, and members are advised to make room reservations as soon as possible. The program for this meeting will be mailed to all AAPT members shortly after the deadline date for abstracts, 10 May 1946. C. J. Overbeck, of the Physics Department, Northwestern University, Evanston, Illinois, is the secretary.

The Society for Applied Spectroscopy is sponsoring a meeting on the subject of spectroscopic nomenclature to be held Saturday, 11 May, at the Pennsylvania Hotel in New York. Duane Roller, of Wabash College, editor of the *American Journal of Physics,* will discuss physics nomenclature in general; B. F. Scribner, of the National Bureau of Standards, will discuss nomenclature for emission spectroscopy; and a speaker to be announced will discuss nomenclature for absorption spectroscopy at the morning session beginning at 9:30.

The afternoon meeting will be devoted to general group discussions of specific proposals presented by special committees of the Society. There will be separate sessions for those interested in emission and in absorption. It is hoped that the final result of the meeting will be the adoption of a definitive nomenclature for all branches of spectroscopy.

The New England Section of the American Society of Plant Physiologists will resume its schedule of annual meetings on 17–18 May at Harvard University. Dr. Kenneth V. Thimann, Harvard University, is chairman, and Dr. Linus H. Jones, Massachusetts State College, is secretary. The meeting will be held in the Harvard Biological Laboratories beginning on the afternoon of 17 May and is open to all interested in the subject of plant physiology.

Elections

Prof. Sidney Chapman, Imperial College of Science and Technology, London, and Peter Leonidovich Kapitza, director of the Institute for Physical Problems of the Academy of Sciences, Moscow, were elected foreign associates of the National Academy of Sciences, which held its annual meeting 22–24 April in Washington, D. C.

Detlev W. Bronk, director of the Johnson Research Foundation, University of Pennsylvania, was elected foreign secretary, while I. I. Rabi, professor of physics, Columbia University, and Walter R. Miles, professor of psychology, Yale University School of Medicine and chairman of the Division of Anthropology and Psychology of the National Research Council, were elected to the Council of the Academy.

Twenty-nine new members were also elected: Samuel King Allison, director, Institute for Nuclear Studies, University of Chicago; Rudolph John Anderson, professor of chemistry, Yale University; Ernest Brown Babcock, professor of genetics, University of California, Berkeley; Kenneth T. Bainbridge, associate professor of physics, Harvard University; Elmer K. Bolton, director, Chemical Department, E. I. duPont de Nemours and Company, Wilmington, Delaware; Wilmot Hyde Bradley, chief geologist, U. S. Geological Survey, Washington; Perry Byerly, professor of seismology, University of California, Berkeley; Paul Roberts Cannon, professor of pathology, University of Chicago; Milislav Demerec, director, Department of Genetics, Carnegie Institution of Washington; Jesse Douglas, associate professor of mathematics, Brooklyn College; Clarence Henry Graham, professor of psychology, Columbia University; Morris S. Kharasch, Carl William Eisendrath Professor of Chemistry, University of Chicago; Karl Paul Link, assistant professor of biochemistry, University of Wisconsin; Robert F. Losh, Lambert Professor of Medicine, College of Physicians and Surgeons, Columbia University; Esmond Ray Long, professor of pathology, School of Medicine, and director of laboratories, Henry Phipps Institute, University of Pennsylvania; Joseph E. Mayer, professor of chemistry, Columbia University; Charles Snowden Pigget, physical chemist, Geophysical Laboratory, Carnegie Institution of Washington; Marcus Morton Rhoades, professor of botany, Columbia University; George Scatchard, professor of chemistry, Massachusetts Institute of Technology; Tracy Morton Sonneborn, professor of zoology, Indiana University; Leslie Spier, professor of anthropology, University of New Mexico; Stanley Smith Stevens, associate professor of psychology, Harvard University; Chauncey Guy Suits, director of research laboratory, General Electric Company, Schenectady; Frederick E. Terman, head of Department of Electric Engineering, Stanford University; Merle Antony Tuve, chief physicist, Carnegie Institution of Washington; Chester Hamlin Workman, head of Department of Bacteriology, Iowa State College; Roger John Williams, director of Biochemical Institute, University of Texas; Frank Clifford Whitmore, dean, School of Chemistry and Physics, Pennsylvania State College; and Wendell Phillips Woodring, principal geologist, U. S. Geological Survey, Washington.

The American Association of Pathologists and Bacteriologists elected the following officers for 1946 at its annual meeting in Chicago on 8 March: Wiley D. Forbus, Durham, North Carolina, president; Malcolm H. Soule, Ann Arbor, Michigan, vice-president; Howard T. Karsner, Cleveland, secretary; Alan R. Moritz, Boston, treasurer; Tracy B. Mallory, Boston, incoming member of Council; and William B. Wartman, Cleveland, assistant secretary.

The American Ethnological Society announces the election on 8 January of the following officers for the year 1946–47: Hortense Powdermaker, Queens College, president; E. Adamson Hoebel, New York University, vice-president; Sherwood L. Washburn, Columbia University, vice-president; Esther S. Goldfrank, Columbia University, secretary-treasurer; Marian W. Smith, Columbia University, editor; and Gladys A. Reichard, Barnard College, Harry L. Shapiro, American Museum of Natural History, and Carl Withers, Brooklyn College, directors.

The American Institute of Nutrition, at a recent meeting in Atlantic City, elected the following officers for 1946–1947: A. H. Smith, president; R. M. Bethke, vice-president; and H. J. Almquist, councillor. H. E. Carter and E. M. Nelson continue as secretary and as treasurer, respectively, and C. A. Elvehjem and D. W. Woolley continue on the Council.

The Louisiana Academy of Sciences has elected the following officers for 1946–1947: Alvin Good, Northwestern State College, Natchitoches, Louisiana, president; John L. Hardin, Centenary College, Shreveport, vice-president; Lauretta E. Fox, Northwestern State College, Natchitoches, chairman of the Biological Sciences Section; H. C. Eshelman, Southwestern Louisiana Institute, Lafayette, chairman of the Physical Sciences Section; Roy E. Hyde, Louisiana State University, Baton Rouge, chairman of the Social Sciences Section; George H. Lowery, Louisiana State University, Baton Rouge, editor; E. A. Fieger, Louisiana State University, Baton Rouge, permanent secretary; and H. Bruce Boudreaux, Louisiana State University, Baton Rouge, secretary-treasurer.

The Limnological Society of America elected the following officers at its recent annual meeting: Paul S. Welch, University of Michigan, president; A. D. Hasler, University of Wisconsin, vice-president; G. L. Clarke, Harvard University and the Woods Hole Oceanographic Institution, secretary-treasurer. All business communications in regard to the Limnological Society should henceforth be addressed to the latter.

The American Society of Plant Taxonomists has elected the following new officers: Philip A. Munz, president; E. E. Sherff, chairman of the Council; and Lincoln Constance, secretary-treasurer.

The American Society for Pharmacology and Experimental Therapeutics held its 34th annual meeting in Atlantic City on 11–15 March 1946. The following officers were elected: Maurice H. Seevers, University of Michigan, president; H. B. van Dyke, Columbia University, vice-president; Harvey B. Haag, Medical College of Virginia, secretary; McKeen Cattell, Cornell University, treasurer. Hamilton H. Anderson, University of California, and Dr. John C. Krantz, Jr., University of Maryland, were elected councilors.

The Branner Geological Club held its annual meeting on 15 March at the California Institute of Technology in Pasadena. Since this was the 25th anniversary of the Club, Dr. Ralph Arnold, a charter member and the first president, told of the formation of the Club and reviewed the life of Dr. John Casper Branner.

New officers elected at this meeting for 1946 are: W. C. Putnam, University of California at Los Angeles, president; W. T. Winham, Standard Oil Company of California, vice-president; Richard Ten Eyck, Continental Oil Company, secretary-treasurer.

Dr. Chester Stock spoke briefly on the Pittsburgh meetings of the Geological Society of America, and Dr. Beno Gutenberg spoke on the earthquake shocks that had been felt during the morning. The principal address was given by Dr. R. Dana Russell, of the University of California Division of War Research at San Diego, on "Geologists and Sonar."

The Association of American State Geologists, which usually meets in Washington, D. C., this year held its annual meeting at Urbana, Illinois, upon invitation of M. M. Leighton, chief of the Illinois Geological Survey. Inspection of the laboratories of the Survey and descriptive papers of the investigations being conducted in them by members of the staff were outstanding features of the three days spent at Urbana. The meetings drew members from all sections of the United States. Addresses were made by W. E. Wrather, director of the U. S. Geological Survey; E. W. Pehrson, representing the U. S. Bureau of Mines; Bruce K. Brown, vice-president of the Standard Oil Company (Indiana); and others. The following new officers were elected: Meredith E. Johnson, of New Jersey, president; A. C. Trowbridge, of Iowa, vice-president; and Edward L. Troxell, of Connecticut, secretary-editor.

The Department of Plant Sciences of the University of Oklahoma has elected Dr. Howard W. Larsh as chairman. It has also recently added the following members to its staff: Dr. George J. Goodman, professor and curator of the Bebb Herbarium; Dr. Norman H. Boke, assistant professor; Dr. Dorothy V. Leake and Dr. Elwyn O. Hughes, instructors; Mr. Robert H. Rucker, landscape architect; Mr. Frank Rinehart, custodian; Miss Marylou Stiemert, Miss Phyllis Thompson, Mr. Tillman Johnson, and Mr. Vernon Scott, assistants; and Mrs. Jean Moore, secretary.

The Union of American Biological Sciences elected the following officers at its recent annual meeting in St. Louis: Robert Chambers, New York University, president; J. S. Karling, Columbia University, secretary; and Frank A. Brown, Jr., Northwestern University; M. Demerec, Carnegie Institution; and Robert F. Griggs, National Research Council, Executive Committee members.

The American Physiological Society has elected the following officers for 1946: Wallace O. Fenn, president; Maurice B. Visscher, secretary; D. B. Dill, treasurer; and Henry C. Bazett, councilor.

Recent Deaths

Jean-Marie-Eugène Derscheid, ornithologist and conservationist, was imprisoned by the Germans in 1941 and executed on 13 March 1944. He had made several trips to the Congo, one of them with the American expedition for studying gorillas, which were headed by Carl Akeley. Dr. Derscheid was the principal promoter of Réserves Naturelles in the Belgian Congo and effected establishment of Le Parc National Albert, of which he was made director. He was an enthusiastic aviculturist, studying in particular the Anatidae, and he was the artist who designed the fine Gyrfalcon on the cover of *Le Gerfaut.* In this journal (1945, **35,** 109–111) Charles Dupond gives an account of Dr. Derscheid's contributions to science and conservation.—*Margaret M. Nice* (Chicago, Illinois).

In the Laboratory

Nucleosis of Skeletal Muscle: Its Value as a Biological Test[1]

RUDOLF ALTSCHUL

Department of Anatomy, University of Saskatchewan
Saskatoon, Canada

Damage to skeletal muscle which is not severe enough to cause necrosis provokes not only alterations in the sarcoplasma but intense proliferation of subsarcolemmal nuclei (nucleosis). Such damage may be caused by mechanical or toxic agents, by ischemia or avitaminosis-E; its nature may be unknown, as in either progressive muscular dystrophy or in denervation. The nuclear proliferation is frequently so active that the nuclei fill the sarcolemma producing the "nuclear tubes" of Waldeyer. If nucleosis occurs only in restricted zones of the fiber, it results in "muscle giant cells" or in "fiber clubs."

This proliferation may be interpreted as regenerative or as reactive in nature. It may, however, constitute the initial stage of a metaplasia of skeletal muscle into connective tissue. There is no agreement as to the manner in which the numerical increase of muscle nuclei occurs. While some authors believe that the proliferation is due to mitosis (A. M. Pappenheimer, *3*; Chor, Dolkart, and Davenport, *2*), others regard the process as "amitotic" (Tower, *4*; Altschul, *1*). Whether amitosis occurs at all, whether it is the division of damaged cells, or whether it is limited to syncytia are questions that are still under discussion. A solution of this problem regarding skeletal muscle would not only have a theoretical interest but might explain certain features in muscle degeneration and lead to an improvement of measures for the prevention of muscle degeneration.

If mitosis of subsarcolemmal nuclei does occur in denervated or otherwise damaged muscle, it should be easy to find mitotic figures amongst the great number of recently proliferated nuclei. The writer has examined several hundred sections showing nuclear proliferation in muscle fibers but has been unable to find clear evidence of mitosis; yet there have been many indications of amitosis, in the form of constrictions and, even more frequently, of fissures. These latter were especially clear if the sections were stained with cresyl violet instead of the standard hematoxylin-eosin.

Since the apparent lack of mitotic figures and the presence of morphological changes, suggesting amitosis, are insufficient to justify a final decision on the nature of this nuclear proliferation, an attempt has been made to obtain more conclusive evidence by the use of colchicine. The procedure and preliminary findings were as follows: The skeletal muscles of rabbits, guinea pigs, and white rats were denervated or locally injured by the insertion of catgut or cotton threads. Three months after denervation nucleosis and other histological changes are very pronounced. Subcutaneous injections of 0.2–0.3 mg. of colchicine per 100 grams of body weight, 4 or 9 hours before the animal was killed, failed to arrest a hypothetical mitosis, and the "colchicine effect," with its apparent or real numerical increase of mitotic figures, was lacking. The decomposition of proliferated nuclei was more pronounced than in control cases.

Focal injury by threads permits one to observe and analyze the degree of muscle damage and of tissue reactions. It is found in cross-sections that the dif-

---

[1] Supported by a grant from the National Research Council of Canada, Associate Committee on Army Medical Research.

ferent pathological changes are arranged concentrically. In the center is the thread or the space through which it passed, surrounded or filled by necrotic masses. Next are reactive and reparative processes of inflammatory type, then hyaline muscle fibers, and outside these an occasional layer of calcified (previously hyalinized?) muscle fibers. Still further out are "muscle giant cells" or fiber clubs with proliferated nuclei, then thin muscle fibers with less marked nucleosis, and finally, normal muscle with some interstitial reaction. As may be expected, there is often some overlapping of these zones. If the injury and reactions are slighter, the hyalinization, calcification, and nuclear proliferation in the muscle fibers may be absent.

Following these injuries the effects of colchicine and other substances may be determined. If, after local injury to muscle, colchicine is given in repeated doses over a 5- to 10-day period, nucleosis will be slight or entirely absent. But if a single dose is administered 5 to 10 days after the injury and the animal killed 4 to 9 hours later, nucleosis will be present. In neither case have any mitotic figures been found. Sodium cacodylate is reputed to have an action similar to colchicine. Its use in these tests failed to bring out mitotic figures in the damaged muscle or to influence nucleosis, though enlargement of many nuclei occurred. When quinine sulphate or quinine chloride was given to animals with local injuries of skeletal muscle, an increased nucleosis was observed. X-ray irradiation of locally injured muscle had so far no influence on nucleosis.

In carrying out the experiments with colchicine, sodium cacodylate, and quinine, it was found desirable to bring these substances into more intimate contact with the tissue, showing nuclear proliferation. Prior to insertion, the threads were impregnated with the test substance which was used in aqueous or aqueous-gelatinous solution.

The above-described procedure by which muscle tissue is injured locally and acted upon more or less contemporaneously (a) through the general circulation, by introducing drugs either orally or hypodermically, (b) locally, by impregnating the introduced threads with the drug, and finally (c) by the combination of (a) and (b), should prove helpful as a biological test to ascertain the influence of certain substances on pathological processes in skeletal muscle.

Addendum: Since this paper was submitted for publication, W. E. Le Gros Clark has published an article (*J. Anat.*, 1946, 80, 24) in which he describes the use of colchicine for ascertaining the lack of mitotic division in injured skeletal muscle. No mention is made of the influence of the drug on amitotic proliferation.

References

1. Altschul, R. *Arch. Path.*, 1942, 34, 982.
2. Choe, H., Dolkart, R. E., and Davenport, H. E. *Amer. J. Physiol.*, 1937, 118, 580.
3. Pappenheimer, A. M. *Amer. J. Path.*, 1939, 37, 179.
4. Tower, S. S. *Physiol. Rev.*, 1939, 19, 1.

On the Fluorometric Determination of Nicotinamide[1]

John V. Scudi[2]

Department of Pharmacology, College of Physicians and Surgeons, Columbia University

After Najjar's detection (*8*) of F_2, a metabolite of nicotinamide, fluorometric methods for its determination were developed (*2, 6*). Although F_2 is measured fluorometrically, investigators are still obliged to measure concentrations of nicotinamide colorimetrically. A simple means of measuring both substances fluorometrically is, therefore, desirable.

When it was shown that F_2 is an N-methyl-β-formamidopyridinium salt (*3, 4, 7*), it became evident that the fluorometric methods for the determination of F_2 can be used for nicotinamide if the latter substance can be converted to F_2. N-methylation of nicotinamide was carried out (*5*) under reflux conditions for six hours with excess methyl iodide. It has now been found that this reaction can be effected more simply by allowing dilute methanolic solutions to stand overnight at room temperatures in the presence of excess methyl iodide. The excess methyl iodide is readily removed by evaporation under a current of air. The product, treated with alkali and isobutanol, may then be measured fluorometrically according to the method described by Najjar (*6*). Thus, given a solution of nicotinamide and N-methyl-nicotinamide chloride, the metabolite is measured as usual, and after treatment with methyl iodide, a second analysis gives the sum of the metabolite and the nicotinamide.

In the course of this work, which has since been discontinued, a simpler and more rapid method for the fluorometric measurement of nicotinamide was found. The method involves treatment of aqueous solutions of nicotinamide with cyanogen bromide according to Bandier and Hald's colorimetric method (*1*). Instead of adding the metol solution to complete the color reaction, alkali is added; the product is extracted with isobutanol, and readings are taken fluorometrically as described by Najjar (*6*). Unlike pyridoxal, the pyrimidine moiety of thiamine and certain alkaloids, the following do not interfere: pyridine, nicotinic acid, methyl nicotinate, pyridoxine, and pyridoxamine. When the test is performed as described,

---

[1] Thanks are due Mr. J. C. Hornberger for his assistance.

[2] Affiliated with Merck and Company, Rahway, New Jersey, when this article was prepared.

nicotinamide gives rise to a greater fluorescence intensity than an equivalent weight of N-methyl-nicotinamide chloride. This unexpected increment is quite pronounced, and, as a result, one may measure as little as one microgram of nicotinamide. The fluorescence is stable, and measurements are reproducible. The method appears to be simpler, more sensitive, and more reproducible than existing colorimetric methods.

References

1. Bandier, E., and Hald, J. *Biochem. J.*, 1939, **33**, 264.
2. Coulson, R. A. *Nature, Lond.*, 1944, **154**, 547.
3. Ellinger, P., and Coulson, R. A. *Nature, Lond.*, 1943, **152**, 383.
4. Huff, J., and Perlzweig, W. A. *Science*, 1943, **97**, 538.
5. Karrer, P., Schwarzenbach, G., Benz, F., and Sollmsen, U. *Helv. chim. Acta*, 1936, **19**, 826.
6. Najjar, V. A. *Bull. Johns Hopk. Hosp.*, 1944, **74**, 392.
7. Najjar, V. A., Scott, D. B. M., and Holt, L. E., Jr. *Science*, 1943, **97**, 537.
8. Najjar, V. A., and Wood, R. W. *Proc. Soc. exp. Biol. Med.*, 1940, **44**, 386.

Chloride-free Filter Paper

Daniel Cushing, *Boston, Massachusetts*, and Ralph N. Prince and Joseph Seiberlich, *Engineering Experiment Station, University of New Hampshire, Durham*

In recent years considerable emphasis has been placed on the purity of reagent chemicals—so much, in fact, that manufacturers have found it necessary to include the analysis on the labels. Nevertheless, no restrictions upon the purity of the filtering media used in analytical work have been mentioned in laboratory procedures. Small quantities of impurities have little significance in macroanalytical work, but become proportionately serious when microanalytical procedures are used.

Benedetti-Pichler (*1*) has recommended Schleicher and Schuell filter papers No. 589 (black or blue ribbon) and No. 601 (spot test paper) in the experiments which he has outlined. In no instance has he indicated the degree of chemical purity of the above papers, although it is stated that "as a rule, the efficiency of the tests is greatly affected by the type of paper used." In an earlier work the above author and Spikes (*2*) have referred the reader to the silver test of the caution group in a discussion of the identification of the chloride ion. No caution concerning possible contamination by the filtering medium was mentioned. Chamot and Mason (*3*) in their descriptions of filtering methods for chemical microscopy, have not indicated that the filtering medium must be of any particular quality. It may be that the false concept that filter paper is pure cellulose still persists.

The recent Federal specifications (*6*) for filtering paper have not mentioned the chemical purity of the product; however, by private communication it has been found that they refer to the usual analytical operations and that no consideration was given to special tests such as might be required in biological or microanalytical work.

There are some analyses in the biological and metallurgical fields where the presence of certain ions, particularly chloride ion, in the filter paper could lead to false conclusions. An example of ion interference in metallurgical work is that of the chloride ion in corrosion studies. Here microanalytical filtering technique is employed together with microscopical identification methods. In studying the corrosion of metals, particularly that of stainless steel, the test for chloride ion is very important. Filter paper is often necessary when analyzing the minute quantities of films and deposits by the various techniques of chemical microscopy. Inasmuch as such corrosion studies call for definite negative results as well as uncontaminated positive results, it can be seen readily that traces of chloride ion would introduce serious interference.

If a circle of a commercial filter paper is shaken with redistilled water until it is well pulped, the fact that chloride is present can be easily confirmed. When the water is removed by decantation or centrifuging and tested for chloride ion, a positive result will be obtained.

Proper and Green (*4*) have stated that a hypochlorite bleaching is usually used in the preparation of pulp for filter paper, and that all of the bleach must be removed with pure water. W. Schmid (*5*) has indicated that chlorine gas as well as hypochlorite is used in the manufacture of high-grade Swedish filter papers, and that thorough washing must be done to remove the chlorides. Nevertheless, chloride ion has been found in all of the papers tested.

Since chloride-free filter papers are not available commercially, a method for obtaining these has been worked out. The demand for a filter paper of this type would normally be rather small, and, since it would not be practicable to store much material for long periods of time, the method has been so arranged that any chemist can prepare his own filter paper as required.

The Federal specifications have called for 100 per cent rags as raw material. But, the history of the rags being unknown, it would be quite possible for traces of chloride to be present from previous bleaching operations. Therefore, unbleached sulfite wood pulp was chosen as the raw material.

The pulp was bleached with sodium peroxide, although any bleaching agent which contained no chlorine could have been used. First, 5 per cent sodium peroxide, based on the pulp weight, was dissolved in water and then thoroughly mixed with the pulp at approximately 10 per cent consistency. The reaction was allowed to proceed overnight at room temperature, after which the temperature was raised to 50° C. for an hour. The spent liquor was drawn off, and a second treatment with sodium peroxide of the same strength was carried out for an hour at 50° C. Inasmuch as the unbleached sulfite pulp was not iron free, the bleached pulp was steeped for 15 minutes in a 1-per cent oxalic acid solution in order to remove the iron. It was then washed free of oxalates with distilled water, since tap water usually contains chlorine. A filter paper made from a pulp thus treated was chloride free, but its ash content corresponded to that of qualitative paper.

Reduction of the mineral content of the pulp without introducing chloride could be accomplished in several ways. Such acids as sulfuric, phosphoric, and oxalic, or mixtures of them in various strengths, could be used. In the present work, the pulp was mixed with a sufficient quantity of 10 per cent orthophosphoric acid to result in a consistency of about 5 per cent. It was heated to 50° C. for 15 minutes, the acid was filtered off, and the filter cake was washed free of phosphates.

In commercial preparation, it could be expected that traces of phosphate ion might remain in the pulp even though it was thoroughly washed. Therefore, when microdeterminations are made for phosphate ion, it would be best to use a standard filter paper from which the ash has been removed by hydrochloric acid. Pulp treated thus had an ash content comparable to that of commercial quantitative filter papers.

A high-speed laboratory stirrer was used to break up the pulp at a consistency of 1 to 2 per cent, after which it was thickened to the desired degree for bleaching. The purified pulp was dispersed in a similar manner in distilled water at about 0.5 to 1 per cent consistency. The filter paper was formed on a finely woven, cotton fabric which had been placed over the holes of a Buchner funnel of the size desired. The sheet was formed while the water was removed slowly by reducing the pressure slightly in the filter flask. When the water had been removed, full suction was applied. Then the sheet was wet with alcohol (chloride free) to harden it. The sheet was transferred to a glass plate, pressed, and then dried.

References

1. BENEDETTI-PICHLER, A. A. *Microtechnique of inorganic analysis.* New York: Wiley, 1942. P. 49.
2. BENEDETTI-PICHLER, A. A., and SPIKES, W. F. *Microtechnique of inorganic qualitative analysis.* New York: Wiley, 1935.
3. CHAMOT, E. M., and MASON, C. W. *Handbook of chemical microscopy.* (2nd ed.) New York: Wiley, 1940.
4. PROPER, J. B., and GREEN, B. S. *Pap. Trade J.*, 1920, **89**, 68.
5. SCHMID, W. *Papierfabr.*, 1929, **27**, 187–190.
6. ———. *Fed. stand. Stock Cat. UU-P-236*, 7 April 1944.

Letters to the Editor

Science and Mankind's Plight

In his recent address at the AAAS meeting in St. Louis (*Science*, 1946, 103, 337), Dr. A. J. Carlson clearly depicts the dilemma mankind is in about the state of human affairs.

Dr. Carlson sees a helplessness in every direction that has us puzzled, much as a doctor who gazes baffled at a person very sick with some disease he does not understand. All leading scientists who have given thought to the world's troubles feel about them as he does.

This was very frankly admitted by Wesley C. Mitchell, then of Columbia University, in his striking address as president of the AAAS at the annual meeting of the Association in Columbus, Ohio, in December 1939, when with other things he noted:

"If we can come to a clearer understanding of how we behave, perhaps, and perhaps is all we can say, we can learn how to condition men so that their energies will go less into making one another miserable. . . .

"The outside limits of what scientists can accomplish as citizens are set by their ignorance. Not only does no individual have more than a tiny fraction of the knowledge that is needed; all scientists of the country put together do not know enough to solve many of the problems that a democracy faces."

Since Dr. Mitchell's address, great changes for the worse have come over the world, and the darkness now is much darker than at the time he expressed those views. The baffling problem now is to know how science can break through this darkness to save mankind, for only science can do that.

Dr. Carlson sees hope for betterment if the integrity ruling in science can be injected into the common life of the people. He now sees dishonesty, guile, deceit, and the Golden Rule in reverse, which is only too true, pervading and governing so much that is going on in the Nation and the world.

Since the desire for money is mainly the cause of this, it being regarded as an end rather than the means, which it really is, perhaps the social evils and human deterioration caused by money being so regarded will pass away when money ceases to be the power it now is.

In the coming atomic age nuclear energy will be the driving power of the social order.

The foregoing are not the views of a scientist; they are those of a layman who has taken a keen interest in certain branches of science for many years. Though he has worked as a machinist in a war plant until recently, and spent his life prior to that in the mines in South Wales and America as a miner, he has reflected a good deal on some of the major problems of life.

G. Edgar Owen
Harris Building, Honesdale, Pennsylvania

The Atomic Bomb and the Anthropologists

In his admirable address, "Science and Our Future" (*Science*, 1946, 103, 415–417), Dr. E. U. Condon very properly criticizes the viewpoint of anthropologists who "fatalistically await death, reading papers to an academic society meeting in a museum in Philadelphia." I think it should be placed on record that almost all the anthropologists present at that meeting rejected that viewpoint, and that upon my moving and Dr. Margaret Mead seconding, the following resolution was unanimously adopted by the American Anthropological Association:

Resolved: That the American Anthropological Association, constituted of scientists interested in the study of human nature and society, recognizes the responsibility of anthropologists to study the effects of the discovery of the use of atomic energy, and to participate actively with other scientists in efforts to make appropriate social inventions to guard against the dangers, and utilize the promise, inherent in atomic use.

M. F. Ashley Montagu
Hahnemann Medical College, Philadelphia

Pathogenesis of Kernicterus

The purpose of this communication is to present our concept of the pathogenesis of kernicterus (jaundice of the nuclear masses of the brain), based on recent clinical, serological, and pathological observations. Until recently there was no explanation for the post-mortem finding of kernicterus only in cases of icterus gravis neonatorum (a form of congenital hemolytic disease or erythroblastosis) and not following other types of jaundice, even of severe degree.

As is well known, the great majority of cases of congenital hemolytic disease occur when an Rh– mother, already sensitized to the Rh factor by a previous pregnancy or transfusion, bears an Rh+ fetus. The antibodies in the sensitized mother's serum may be of two principal varieties, namely, bivalent antibodies (agglutinins) and/or univalent antibodies (glutinins or blockers). If the maternal serum contains a high titer of univalent antibodies, the Rh+ fetus will almost surely be stillborn. With low-titered univalent antibodies, viable infants who recover after suitable transfusion therapy are the rule.

In our experience, when the complication of kernicterus supervenes, the antibodies in the maternal serum are almost always of the bivalent variety (agglutinins). This suggests the following mechanism for the development of kernicterus. Maternal Rh agglutinins in the infant's circulation combine with its Rh+ erythrocytes, bringing about the formation of small clumps (agglutinates of red cells) which plug the smaller arterioles with the formation of agglutination thrombi. In an organ like the liver, the resulting damage may be one factor in the production of jaundice, thus explaining its lack of correlation with the degree of anemia. In the bone-marrow, the resulting irritation may cause a pouring forth of nucleated red cells into the circulation. In the brain, plugging of terminal vessels can produce areas of ischemic infarcts; the nuclear masses would be most vulnerable, since ganglion cells are particularly susceptible to anoxia. Due to the concomitant presence of deep jaundice, the damaged ganglion cells take up bilirubin—a sort of *in vivo* staining reaction. If the infant dies at this point, post-mortem examination will show the presence of kernicterus. Infants surviving the immediate neonatal period and dying after the jaundice has disappeared will show at post-mortem examination evidence of cerebral damage but without kernicterus. In a recent case studied by us, where death occurred 48 hours after birth, in addition to the post-mortem finding of kernicterus, histologic study showed the blood vessels of the brain to be packed full by agglutinated masses of erythrocytes, as required by our theory.

Infants with kernicterus occasionally survive, in which case they develop signs of a diffuse neurologic disorder of varying severity, usually accompanied by mental deficiency. Such cases are rare and would be expected to make up only a very small fraction of the group of so-called nonspecific mental deficiency cases. Therefore it could be predicted a priori that attempts such as have recently been made to show a statistical difference in the distribution of the Rh factor among mothers of mentally deficient children in comparison with the normal population would almost surely yield insignificant results unless the series is large enough to detect a small percentage difference.

Attempts have been made to show a connection between Wilson's disease and kernicterus. In three cases of Wilson's disease studied by us we found no evidence of isoimmunization of pregnancy, indicating a dissimilarity in the pathogenesis of the two conditions.

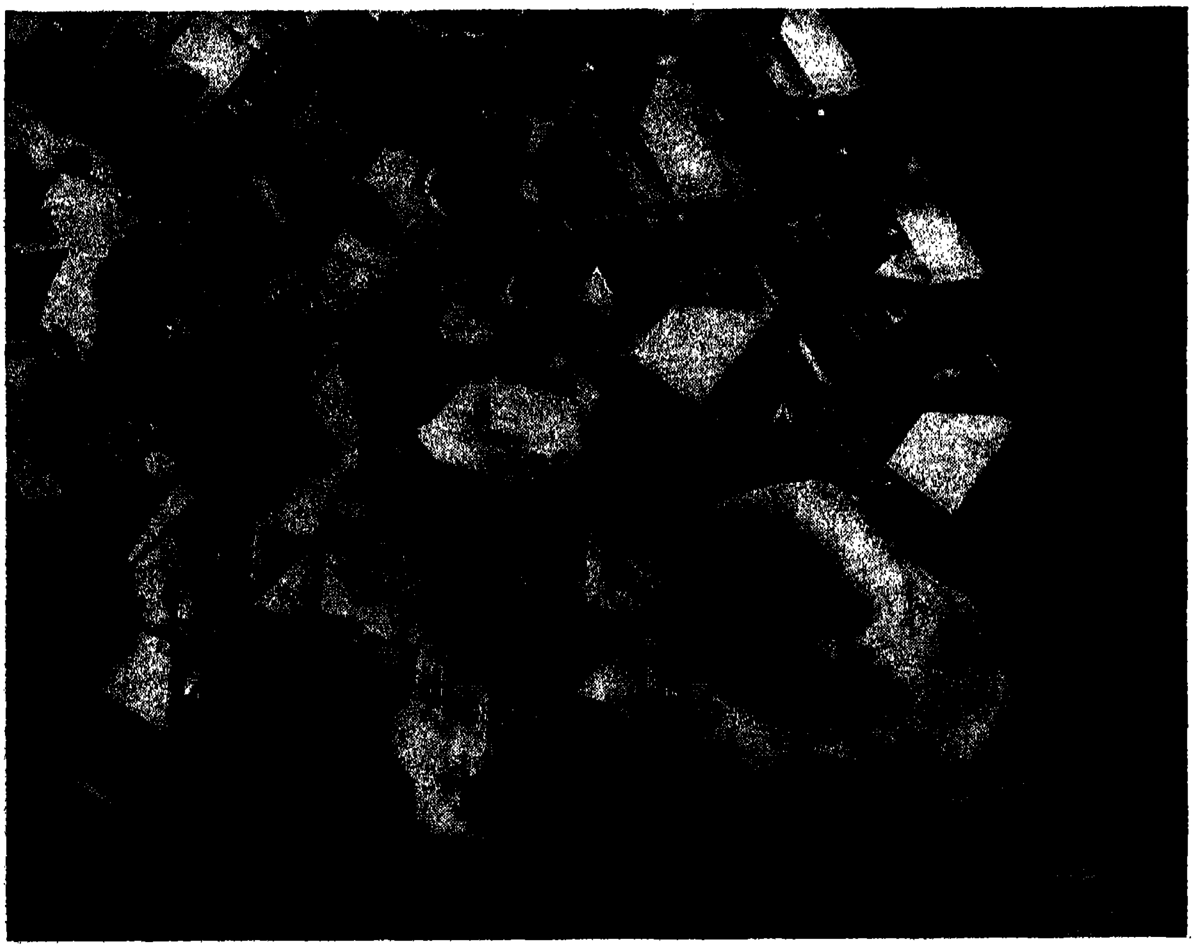
Alexander S. Wiener
Serological Laboratory, Office of the Chief Medical Examiner, New York City

Matthew Brody
Department of Neurology, Brooklyn Jewish Hospital

Genetics and Biological Theory

E. B. Wilson, in his classical work (*The cell in development and heredity*. New York: Macmillan, 1928), states: "In practice all purposes of experimental analysis are sufficiently met if the hereditary 'units,' 'genes' or 'pangens' be thought of merely as modifiers which call forth responses, this way or that, according to their

Quality – Based on Standards and Craftsmanship



A Diamond *and* the Rough

Optical lenses and prisms, formerly had to be separately and accurately mounted in pitch or plaster of Paris for rough and fine grinding and polishing. Today, more and more of these Bausch & Lomb optical elements are diamond milled before polishing. Optical parts are quickly and accurately set up in special precision jigs and speedily surfaced with diamonds on huge precision milling machines. Thus, today, Bausch & Lomb optical elements are fabricated with better control of dimensions . . . faster. Bausch & Lomb Optical Co., 642-5 St. Paul St., Rochester 2, N. Y.

BAUSCH & LOMB

ESTABLISHED 1853

specific nature. To speak of them as 'determiners' is to make use of a convenient figure of speech; but this need imply no more than that they are differentials by the use of which we are enabled accurately to analyze the observed results'' (p. 1113). To take this concept to its logical conclusion has a radical effect upon biological theory, as the writer has shown in a series of papers on the causes of color patterns. It is preferable to use the term ''inhibitor'' rather than ''modifier,'' since the latter has a more restricted meaning in genetics, and extend to the whole of genetics the concept of inhibiting factors which is used to explain melanin pigment inhibition in animals. The concept of hereditary factors as inhibitors is not generally used by plant geneticists, though the evidence is in its favor. Thus, the chromosome-borne inhibitors in albino plants are quite obviously responsible for the inhibition of plastid development, which may be complete as in white plants, or incomplete inhibition as in yellow plants, with still less inhibition for red-colored plastids (chromoplasts). Since flower color is caused by sap pigments produced by plastids, or chromoplasts, or both, then the inhibiting factor hypothesis has only to be extended to include the selective inhibition of one or more of the three primary pigments produced by the plastids, namely, red, yellow, and blue, or incomplete inhibition of the plastids themselves, together with a time variable when the inhibitors become effective, to account for color patterns. In animals there is no evidence that chromosome-borne factors are responsible for melanin pigment synthesis but only its partial or complete inhibition, the variegated patterns being caused by the time when the inhibiting substances appear in early or fetal life. The evidence points to black color as being the uninhibited expression of melanin pigmentation, and hence the conventional multiple allelic series in rodents is each reduced by one, namely, normal black color. Thus, the agouti series in rabbits has only two members, agouti or wild-type, and black-and-tan, normal black color occurring in the absence of these inhibitors provided no others are present.

The inhibitors arise spontaneously, as evidenced by mutations, and range from the dominant, gross type to those of the modifying or regulatory class, the latter being responsible for the nongenetically fixable grades of white spotting and size. The breeding methods of inbreeding, outcrossing, and selection are used for the purpose of attempting to fix the desired types of inhibitors and purge the organism of unnecessary ones. Thus, inbreeding maize purges the plant of some inhibitors but renders others homozygous. The crossing of two inbred strains which are homozygous for a maximum number of different inhibitors will yield the most vigorous hybrids. If the inhibitors could be destroyed, especially selectively, the breeding methods would be simplified. Submitting organisms to X-rays merely increases the number of harmful inhibitors or produces lethal effects through chromosome breakages. However, the inhibiting substances produced by the inhibitors can be neutralized in many cases. An extreme example is seen in the use of plant hormones as herbicides which seem to neutralize cellular inhibiting substances to the extent that the plant grows itself out.

The implication of the inhibiting factor hypothesis is that growth is an inherent characteristic and the chromosome-borne factors merely inhibit metabolism in varying degrees. In other words, under optimum conditions of temperature, light, and nutrition and with a minimum of internal inhibitions caused by chromosome-borne inhibitors, together with an absence of toxic products of metabolism or the neutralization of such, cell growth would be at its maximum rate, and differentiation would not occur. This view has some support from tissue-culture experiments. It is also supported on evolutionary grounds. Thus, the first spontaneously originated compound to form organic matter must have had the constitutional characteristic for its own duplication and hence growth; it could not have acquired this characteristic, as it could not have survived to do so. What would be necessary would be a breaking up of the organic mass to prevent it from becoming a victim of its own toxic products of metabolism. The spontaneous origin of inhibitors would provide the necessary mechanism, since inhibitors have the characteristic of repulsion after duplication, as is evident in mitosis and by inference also in single-celled organisms. Evidence that complex molecular entities duplicate themselves is seen, in addition to the chromosome-borne inhibitors, in plastids and virus molecules, all of which require the specific organization of the cell to do so.

Alan Deakin

Experimental Farm, Ottawa, Canada

Are Scientists Irresponsibles?

The leading article, ''Can we curb the irresponsibles?,'' by Lawrence K. Frank (*Science*, 1946, **103**, 349–351), deals with a most important matter on which clear thinking is eminently desirable, but after reading it three times, I find myself much confused. Perhaps I am unduly obtuse, but I need clarification of Dr. Frank's position.

I wholly agree that responsibility for aggression must be brought home to the guilty individuals and adequate punishment inflicted on them, and that the Nürnberg trial is, therefore, fully justified and is based on principles which must be maintained if we are to hope for lasting peace.

But Dr. Frank seems to proceed from this sound basis to the propositions that scientists, by working on atomic bombs are guilty of aggression and may be held liable to punishment, and that an association of scientists may be able by their own action to relegate the atomic bomb to extinction. I cannot follow him on either of these points.

Surely there is a clear distinction between contributing to our military power and using that power for aggression. The scientific work which produced the atomic bomb differed not in character but only in effectiveness from other scientific work which contributed to the development of faster fighting planes, more powerful bombers, air-borne radar for strategic bombing, proximity fuses, and the innumerable other new weapons of the most technological of wars. In that war, in which we were the victims of aggression, it was the obvious duty of every scientist to give our armed forces all the help he could. Now that the war is ended, but firm peace not yet achieved, it remains the duty of every good citizen, including the scientist, to do what is needful to maintain our national strength in order that we may lead in the firm establishment of a strong international organization. Should our Government misuse that strength to start an aggressive war, the scientist, like all other citizens, no more and no less, would share in the guilt if he acquiesced.

As for the second point, while we all earnestly hope that never again will an atomic bomb be dropped on human beings, the only insurance against it is the creation of an international organization strong enough to outlaw the use by any nation of the atomic bomb and other weapons for mass slaughter, to enforce its law by adequate policing, and to inflict individual punishment for infractions. No voluntary association of scientists can exercise such governmental powers. It seems to me unfortunate to deflect attention from the only true remedy by raising hopes in a measure which is certain to prove inadequate.

L. A. HAWKINS

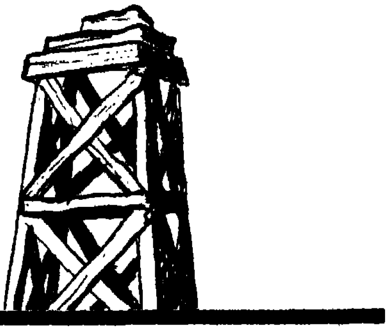
Research Laboratory, General Electric Company
Schenectady, New York

Book Reviews

Chemical crystallography: an introduction to optical and X-ray methods. C. W. Bunn. Oxford, Engl.: Clarendon Press, 1945. Pp. xii + 422. (Illustrated.) $7.50.

The author's purpose, as stated in the Preface, is to present a practical guide to optical and X-ray methods for the identification of solid substances and for the determination of atomic configurations in crystals. His treatment of the subjects is designed primarily to introduce the chemist to those techniques and to provide him with a sufficient background to enable him to begin to apply the principles. In accomplishing his purpose, the author has been highly successful. The success is due, in great measure, to the simplicity of the presentation. Mathematics, for instance, has been kept to a minimum consistent with a thorough understanding of the practical applications of crystallography.

The subject matter is divided into two sections. The first, dealing with identification, is concerned with the use of morphological characteristics, indices of refraction, and X-ray powder patterns in chemical analysis. Elementary crystal theory, including symmetry, nomenclature of planes, growth features, etc., is clearly presented. The meaning of the refractive indices and their measurement and use in identification are particularly well developed.

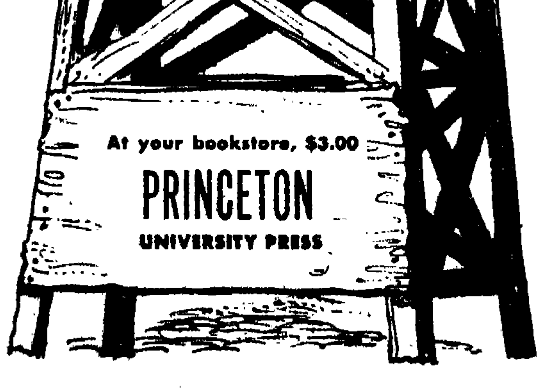


The boisterous saga of America's oil pioneers . . . capturing the restless, enterprising spirit of the great figures of wildcatting — from Williams, Drake, and Galey to Joiner and Gutowsky— and the excitement of life in the oil boom towns. A lively, informal history by a veteran operator and scout.

A selection of the *SCIENTIFIC BOOK CLUB*

THE
Wildcatters

By SAMUEL W. TAIT, JR.
Illustrated with photographs.



At your bookstore, $3.00
PRINCETON
UNIVERSITY PRESS

The second section is devoted to structure determination and is an excellent introduction to both its theory and applications. Of particular merit is the use of the reciprocal lattice concept at the beginning of the development of single crystal techniques rather than in a later section, as is customary. In the reviewer's opinion, considerably more emphasis could profitably have been put on the various moving-film methods. These techniques, which are more powerful and easier to interpret than the rotation method, deserve a full discussion for the student being introduced to X-ray diffraction.

In regard to the physical make-up of the book, the author is to be commended for the general excellence of the line drawings, most of which were made especially for the purpose. The inclusion of a section of selected references for the various topics covered would have been an improvement, since no introductory volume can be expected to cover all phases of the subject thoroughly and additional reading is necessary.

On the whole, the present volume is a very worthwhile contribution. It should find widespread use as a text in the study of structural crystallography.

JOSEPH S. LUKESH

Crystallographic Laboratory
Massachusetts Institute of Technology

Principles of dynamic psychiatry: including an integrative approach to abnormal and clinical psychology. Jules H. Masserman. Philadelphia: W. B. Saunders, 1946. Pp. xix + 322. (Illustrated.) $4.00.

In the author's own words the purpose of his book is "to provide an orientative introduction to the principles of modern dynamic psychiatry, to outline their application to the techniques of clinical diagnoses, and to demonstrate the rationale and methods of effective therapy." All this in a little over 200 pages of text! Admittedly, Dr. Masserman has set himself a difficult task. If he does not wholly accomplish it, it will surprise no one who possesses any familiarity with this field. Actually, he has made an excellent approximation to his goal, even if he has not quite hit the bull's-eye.

The book is so condensed, so concentrated, that one doubts whether it could possibly convey much meaning to the uninitiated, to the uninstructed reader, however zealous his ardor for learning. Added to this, the author's liking for twenty-five-dollar words (such as "frustraneous," "semeiotic," "circumambient milieu," "temporal desuetude," "identificatory," and "neurogenetic dynamisms") is such that the result is a turgidity and stickiness of style which makes reading sometimes difficult. One gets the feeling of having eaten a meal of K-rations covered with blackstrap molasses. It is very much to be hoped that before the companion text, *Practice of dynamic psychiatry*, appears Dr. Masserman will take his blue pencil firmly in hand and apply it vigorously to all such cant phraseology. If he does, the volume will be a useful addition to expository literature. For there can be no doubt whatever that Dr. Masserman knows his subject. His brilliantly chosen and succinctly put case histories are in themselves evidence of this.

He has, moreover, a mature discrimination and a philosophically holistic point of view which will commend itself to the sophisticated student and is rarely found in an experimentally gifted specialist.

CARL BINGER

125 East 73rd Street, New York City

Basic electrical engineering: circuits, machines, electronics. A. E. Fitzgerald. New York and London: McGraw-Hill, 1945. Pp. ix + 443. $3.75.

Planning an electrical engineering course for students majoring in other subjects becomes an ever more difficult task, because the number of topics that might be treated increases with technological progress, while the time allowed for the course usually decreases. Obviously there comes a time when more and more subject matter cannot be crammed in, and it becomes necessary to re-evaluate the field, select only that material which is of current or likely future importance, and organize it into a new whole. This is what the author has attempted in *Basic electrical engineering*, with what appears to be a high degree of success.

The treatment is directed toward the user of electrical engineering apparatus and is by no means a condensation of a complete major course in electrical engineering, as is unfortunately the case with many texts in this field. Emphasis is on external characteristics with only such discussion of the inner workings as is necessary to an intelligent understanding of the equipment. Consistent with modern electrical engineering technology, the treatment of direct-current equipment is subordinated to that of alternating current. Motors are emphasized in comparison with generators, as is appropriate in a text directed to potential users of electrical tools. It is noteworthy that fully one-third of the text is devoted to electronic circuits and equipment.

In style the book is very readable. The theoretical developments are simple and direct, and where there are departures from generality or complete rigor for the sake of brevity some note of this is usually made. Free use is made of electrical engineering short cuts, such as equivalent circuits, vector diagrams, and complex notation. While these are explained adequately, students not proficient in mathematics might have difficulty in grasping the ideas in some cases. There are illustrative examples throughout the book and a fine collection of problems at the end of each chapter.

The book is well designed; diagrams are clear and properly labeled; and there is an appropriate selection of illustrations suitably placed in relation to the text. Typographical errors exist in no more than normal numbers.

B. R. TEARE

Carnegie Institute of Technology

JUL 1946

SCIENCE

Vol. 103, No. 2680 Friday, May 10, 1946

The Impact of the War on Medicine

A. N. Richards

Vice-President, University of Pennsylvania, and *Chairman, Committee on Medical Research, OSRD*

I AM SPEAKING TONIGHT on the subject of "The Impact of War on Medicine." Impact is defined as collision, and that in turn may imply impetus, damage, or, as in the field of nuclear physics, release of energy. With these several connotations in mind, I shall speak of the impact of the war upon the activities of some of the groups of individuals who constitute the personnel of medicine.

MEDICAL STUDENTS

Before this year ends, the schools of medicine in this country will have graduated some 25,000 physicians whose school training has been compressed into three years of 12 months each instead of the usual four years of 9 months each. About 20,000 of these men, enrolled for military service, received an additional 600 hours of training in military affairs—a burden added to the full medical curriculum—and were subjected to the restrictions of partially regimented living. I have calculated that these figures mean that, as of the present and as of years to come, at least 30 per cent of our physicians who are under 45 years of age, *i.e.* the most energetic fraction of the profession and that to which we look for the urge which drives medicine forward, are men whose training has perforce resulted in greater superficiality in learning, less tenacity of retention of what was learned, and a minimum of that contemplation and discussion from which spring habits of independent thought. How many potential investigators this group contains, and, of these, how many have been permanently diverted from a career of study and teaching is impossible to say, but certainly a serious loss has been guaranteed. Already demands for added and more deliberate training are numerous and are increasing, and they find us lacking in facilities for advanced training which I feel sure we are going to be compelled to supply. Something similar could also be said about teachers. The effects of fatigue and restricted time for reading and research upon enthusiasm and teaching efficiency are so readily understood as to require no labored exposition.

The system of accelerated medical education which was forced upon us and which was not adopted by any other of the countries at war seems to me to have had an impact which may prove to have been calamitous. Its effect may perhaps be partially neutralized if the damage is recognized and if we force ourselves to construct and organize facilities for advanced training not only for the near, but also for the long, future.

PHYSICIANS IN THE ARMY

To provide medical service for an army of 8,000,000 men, the peacetime strength of the Army Medical Corps was increased from about 1,200 to 46,000. This increase included 52 general hospital units and 20

Dr. A. N. Richards will receive the William Guggenheim honor cup **this year from the University of Pennsylvania Club of New York City. The cup is awarded each year to an individual who has brought distinction to the University. Dr. Richards played an important part in bringing about the production of penicillin for war needs, and since 1941 has served as chairman of the Committee on Medical Research of the Office of Scientific Research and Development. The award will be made tonight at a dinner at the Club, 106 West 56th Street, New York City.**

This article was taken from an address delivered at a dinner and symposium entitled "Medicine's Tomorrow," sponsored by New York University College of Medicine on 22 January 1946.

evacuation hospital units, the medical personnel of which, probably numbering about 2,500, were recruited almost without exception from teaching hospitals associated with medical schools. Your own unit (Bellevue) was the 1st General; ours from the University of Pennsylvania was the 20th.

My acquaintance with the effects of the war upon the men who staffed these units is limited almost entirely to those who went out from the University of Pennsylvania school and hospital. After more than two years service in northeastern India, in a climate of torrid heat and rains which, for the greater part of the year, made personal comfort unobtainable, they came back with morale which put us who had stayed at home to shame and with keen enthusiasm for the job ahead. For the three years of their service they had been practicing socialized medicine in the strictest sense—group practice—and now that they are civilians again they want nothing quite so much as a reorganization of affairs at home of such a sort as to minimize the ineffectiveness of individual competitive practice, and by group and institutional organization combinations to obtain the opportunities which shall result in better care for patients and more time for the advancement of their own knowledge. If many of those 72 units had similar experience, the impact of that experience on the trend of medical practice can scarcely fail to be significant.

MEDICAL INVESTIGATORS

With respect to medicine, the first of our permanent civilian scientific organizations to be asked to participate with our armed services in their preparations for war was, I believe, the Division of Medical Sciences of the National Research Council. One of the specified functions of that body, established by President Wilson in 1918, was to bring about cooperation of civilian investigators with the scientific and technical services of the War and Navy Departments. Accordingly, early in 1940, Dr. Weed, chairman of that Division, offered its services to the Surgeons General of the Army and Navy, and in May of 1940 at their request two committees, advisory in matters of military medicine, were appointed.

The usefulness of the discussions which then began between medical officers of the services and civilian experts was so quickly apparent that additional committees and subcommittees were formed, their several assignments corresponding to the breakdown of the problems with which the Services expected to be confronted. By July of 1941 there were 7 main and 32 subcommittees, numbering more than 350 persons. As a result of these discussions the Services were provided with summaries of contemporary medical information applicable to military problems, aid in revisions of the Army Medical Manual, recommendations concerning organization, equipment, methods of prevention and treatment of injury and disease. Of course, questions were raised which could not be answered with existing knowledge, and that in turn brought about plans for investigations.

The NRC is not strictly a governmental agency and does not receive funds from Congress. Late in 1940 a total of less than $90,000 was available for research from funds supplied by the Federal Security Agency, the American College of Physicians, and the Carnegie Corporation—a pitifully small amount in contrast with the tasks envisaged.

At about the time when Dr. Weed was offering the services of the NRC to the Surgeons General, a governmental civilian agency for research in instrumentalities of warfare was being created by Executive Order of the President. This was known as the National Defense Research Committee and was under the chairmanship of Vannevar Bush. Under this Committee were mobilized the country's chemists, physicists, and engineers. Their efforts, now regarded as having been decisively responsible for such developments as radar, proximity fuses, amphibious vehicles, and the atomic bomb, were at once so impressive that President Roosevelt in 1941 ordered the formation of a committee with similar responsibilities in the field of medical science—the Committee on Medical Research. By the same order he created the Office of Scientific Research and Development, within which the two Committees were to operate under the direction of Dr. Bush. The Office and its committees were to be financed from Congressional appropriations.

At its first meeting in July 1941, the CMR arranged an alliance with the NRC groups and thus secured the advantages of their previously acquired familiarity with military medical problems. Dr. Weed, an appointed member of the CMR, was made its vice-chairman, and the Council committees and subcommittees agreed to act in an advisory capacity to the CMR. OSRD funds were assigned to the National Academy of Sciences by contract, under the terms of which the Council was to be reimbursed for the expenses of committee meetings, conferences of investigators, and preparation of reports.

In the four and one-half years which have since elapsed, the Committee has held 122 meetings, or an average of more than two per month; the meetings of the advisory committees and conferences of investigators have come to number nearly 1,000.

The work of the CMR has been done largely through contracts with universities, medical schools, hospitals, and research institutes. Almost 600 such contracts have been executed: in rounded figures, 450 with universities, 50 with hospitals, 40 with research institutes, 20 with other government agencies, and 20 with commercial firms. The expense has been approximately $24,000,000—about enough to finance the cost to us of the war for a space of perhaps three and one-half hours. The number of investigators involved in these studies is nearly 5,500: 1,500 doctors of medicine or philosophy and 4,000 technical assistants.

The list of subjects on which investigation was demanded is long. One purpose was common to all, namely, to increase the applicability of what was already known to the better protection of fighting men against injuries, disease, exposure, and fatigue, whether in camps, transports, naval vessels, or in the field—in the North African desert, in tropical jungles, or in the Arctic. Among the many problems with which we were concerned were: protection against influenza, pneumonia, dysenteries, and gas gangrene; prophylaxis and treatment of streptococcus infections and of venereal disease; discovery and use of a substitute for quinine (taken from us by the Japanese) in the treatment of malaria, the number one menace of the tropics; acceleration of convalescence; prevention and control of bacterial infections of wounds and burns; avoidance and treatment of shock; methods of restoring blood volume after hemorrhage and preservation of whole blood for transport from this country to combat theaters; nerve regeneration and nerve repair following nerve injury; protection of aviators against lack of oxygen, cold, and "blackout"; means for better adaptation of men to extremes of heat, cold, and humidity; protection against poison gases; insecticides and repellents with which to avoid malaria, typhus, and the other insect-borne tropical diseases.

Some of these investigations failed to yield results directly applicable to military medicine, but I am sure that every one has given information which will find a useful place in the advance of medical knowledge; some, however, have been so brilliantly successful in terms of lives saved, lessened disabilities, and increased combat effectiveness that they have justified the entire effort. Furthermore, physicians of the future will have been supplied with effective means, never before available, for their war against disease.

Let me give examples of definite accomplishments:

(1) Means have been found for identifying the two recognizable forms of influenza, and new vaccines have been created which lessen the incidence of this disease. A similar statement can be made concerning typhus and cholera.

(2) A pure polysaccharide, produced from the capsules of pneumococci, was proved to be completely protective against lobar pneumonia.

(3) By experimental studies of the chemotherapy of malaria, the safety of routine dosage with a hitherto little-known drug, atabrin, was assured; from knowledge gained concerning its behavior in the body, our pharmacologists were able to show how often and in what dosage it must be given; and on the basis of this information was built the atabrin discipline of our troops which reduced malaria from its position as a menace more dangerous than Japanese bullets to one of relative inconsequence.

In the same field—malaria—thousands of products from scores of chemical laboratories have been examined by our pharmacologists and clinicians, with the result that we are confident that we now possess at least one new drug, far more effective than anything hitherto known as a suppressive of malaria.

(4) A group of chemists whose peacetime studies had been concerned with the characteristics of proteins, applied their knowledge to the separation of therapeutically useful constituents of human blood plasma. Pure serum albumin in concentrated solutions of small bulk proved to be as effective against shock and also simplified problems connected with shipping space for packages of dried whole plasma. The same chemists succeeded in separating the clotting elements of blood and gave them to the surgeons in the form of pledgets which were wonderfully effective in stopping obstinate hemorrhage. They separated, as a dry powder, the proteins of blood which give us immunity against infections and found this to be effective as a preventive against two virus diseases which have disabled numbers of our troops—measles and infectious jaundice.

(5) The compound now so widely known as DDT was made in a German laboratory 70 years ago. A sample was brought to us from Switzerland in 1942, along with the information that it was extraordinarily effective in killing potato bugs and certain flies. From this beginning American science and industry developed the means by which the typhus epidemic in Naples was aborted and by which future epidemics of that disease can certainly be controlled—by which, too, the efficacy of sanitation against mosquito and other insect-borne diseases will be vastly increased.

(6) With regard to penicillin, Fleming discovered its existence, gave it its name, and predicted its usefulness in 1929. Florey succeeded in purifying a small amount—enough with which to confirm Fleming's prediction. Stimulated by Florey and encouraged by our Government, our biologists learned how to increase its production and our chemists, how further to purify it. Our physicians defined its therapeutic power and its limitations. Our manufacturers, against enormous difficulties, transformed a difficult laboratory experiment into a great industry. In less

than three years they gave to our troops, and to those of our British allies, huge supplies of this tremendous weapon against infections. Thus, a permanent asset to the health and welfare of the human race was created.

These and many others are concrete, tangible additions to the resources of physician and surgeon which have resulted from energy liberated by the impact of war upon American investigators; their continuing and permanent usefulness is certain.

Other less tangible but no less real results can be identified. Some of them are: (1) Recognition by Government, by the public, and by scientists themselves of the value of science as a national asset; (2) increased recognition—indeed, concrete demonstration—of the essential identity of the spirit of scientific inquiry wherever it is to be found throughout the world. The friendships which have been engendered by the collaborations of our own scientists among themselves and by our scientists with those of Canada, Britain, and Australia represent, to my mind, a priceless acquisition; (3) recognition that regimentation in any restrictive sense is abhorrent and that such financial support to science as may be conditioned upon it is unacceptable and adverse to its interests; (4) realization of the advantages which are to be gained from frequent conferences of workers with free exchange of ideas and experience; (5) recognition that scientific industry, unrelieved by leisure, can defeat itself; and (6) recognition—I hope by all of us—of the part played by fundamental, in contrast with applied, research in the advance of science.

The implications of these categories of gains are sufficiently obvious. I should, however, like to say something more concerning fundamental *vs.* applied research.

I think it safe to say that most, if not all, of the useful results which have come out of medical scientific war efforts are in no real sense discoveries; they are rather the developments of discoveries made long before the war in laboratories where knowledge is pursued for its own sake with little regard for utility. Given our scientific population, stirred by the national danger and an intense desire to take part in the war effort; given opportunities which enabled them to understand, define, and discuss the problems which needed solution; given also the money with which to obtain equipment and help for their experimentation—a broadly accurate prediction could have been made of the usefulness of the outcome of the national effort which I have been discussing. Indeed, such a prediction actually initiated the effort.

To me it seems utterly improbable that the factors just named, in any combination, could have produced during the period of the war the discoveries from which these practical results have emerged. Those were the fruits of informed and ardent curiosity together with freedom and means with which it could be satisfied. The only leadership required is that within the mind of the investigator himself. To provide for the future advance of science and the true discoveries which will inevitably accrue, it is only necessary that the present generation of productive scientists be given freedom from intellectual restrictions, optimal facilities, and discriminatingly selected disciples.

Anatomy and the Concept of Analogy

Ernst Scharrer
Western Reserve University School of Medicine

OVER A HUNDRED YEARS AGO Richard Owen formulated two fundamental concepts, homology and analogy. A homologue is "the same organ in different animals under every variety of form and function" (*3*). For instance, the foreleg of a mammal, the wing of a bird, and the pectoral fin of a fish are homologous. An analogue is "a part or organ in one animal which has the same function as another part in a different animal" (*3*). Thus, the gills of fishes and the gills of crustaceans are analogous. These two concepts appear of equal importance, and one might expect that both are by now well documented. Actually, however, comparative anatomy has practically identified itself with the exclusive study of homology. Analogy is considered by many anatomists as a subordinate concept the study of which does not come within the province of comparative anatomy (*7*).

It is true that the concept of homology has provided the basis on which definite morphological and phylogenetic relationships could be established. Whatever work there is still to be done in this field must be oriented along these lines, and the great historical significance of the idea of homology remains undisputed. However, it is also true that the purely morphological and phylogenetic approach to problems of structure has reached a static condition. As in the case of other useful concepts, the heuristic value of homology is not without its limits and has become nearly exhausted. Efforts to develop further the idea of homology have not stimulated anatomical research to any noticeable degree (*6, 10*); indeed, the idea largely disintegrated when faced with the results of experimental morphology (*9*). Some of the defenders of the primacy of homology corroborated rather than refuted this fact (*8*).

In view of the sterility of an anatomy interested only in the historical aspects of structure, it would seem worth while to examine the potentialities inherent in the study of that neglected concept, analogy, *i.e.* the functional correspondence of organs.

The study of analogy offers a wide perspective, inasmuch as it permits the analysis of structures as they represent solutions of functional problems. Böker (*2*) has demonstrated how fruitful this approach is, although he restricted his "Biological Anatomy" to the vertebrates. Actually, the field is much larger, for without the dominating presence of the concept of homology the barrier between vertebrates and invertebrates disappears. This barrier has been magnified out of proportion to its true significance and has rendered anatomy no service other than to limit the study of many problems to the vertebrates. But in spite of their great variety, animals with and without vertebrae are faced with basically similar functional problems—orientation in space, conservation of water, disposal of waste materials, to name only a few. The interest lies in discovering how many different fundamental structural solutions of the same problem have been "invented" by different organisms. The broader the basis on which such inquiries are conducted, the more valuable will be the insight gained with respect to the functional significance of anatomical structures.

The great promise of a reorientation of comparative anatomy along such lines is not hypothetical; it can easily be estimated by glancing through Meisenheimer's (*5*) monumental study of reproduction, Krogh's (*4*) analysis of the mechanisms of respiration, or Baldwin's (*1*) delightful essays on comparative biochemistry. It is difficult to see why this type of investigation should not come within the province of comparative anatomy, even if it is in one way or another based on the concept of analogy. The value of concepts is measured by their influence on research. By this standard the concept of analogy will probably not forever hold the subordinate place which is still assigned to it in comparative anatomy.

References

1. Baldwin, E. *An introduction to comparative biochemistry.* Cambridge, Engl.: Cambridge Univ. Press, 1937.
2. Böker, H. *Einführung in die vergleichende biologische Anatomie der Wirbeltiere.* Jena: Gustav Fischer, 1935, 1937; Davis, D. D. *Turtox News*, 1939, **17**, 93–96.
3. Boyden, A. *Quart. Rev. Biol.*, 1943, **18**, 228–241.
4. Krogh, A. *The comparative physiology of respiratory mechanisms.* Philadelphia: Univ. Pennsylvania Press, 1941.
5. Meisenheimer, J. *Geschlecht und Geschlechter.* Jena: Gustav Fischer, 1921, 1930.
6. Naef, A. *Handb. vergl. Anat. Wirbelt.*, 1931, **1**, 77–118.
7. Nowikoff, M. *Anat. Anz.*, 1935, **80**, 388–392.
8. Söderström, A. *Homologie, Homogenie und Homoplasie.* Upsala: 1925.
9. Spemann, H. Zur Geschichte und Kritik des Begriffs der Homologie. In *Die Kultur der Gegenwart,* Teil III, Abt. IV/1, Allg. Biol., 1915, 63–86.
10. Westenberg, J. *Acta biotheor.*, 1938–39, **4**, 33–50.

Universal Military Service in Peacetime

A Statement by the American Mathematical Society and the Mathematical Association of America

THE WAR POLICY COMMITTEE of the two mathematical organizations was formed to study the many questions of professional and scientific policy arising out of the war. No subject has been of greater interest or more vital concern to the Committee than the relations between scientific effectiveness, on the one hand, and the military requirements of the Nation, on the other. A most important aspect of this subject is treated in the report on "Universal Military Service in Peacetime," recently made public. This report is directed in the main at points upon which mathematicians, as such, are particularly qualified to express informed opinions. Whatever view may ultimately prevail—and it should be emphasized that there are many citizens, mathematicians included, who doubt the wisdom of introducing

In July 1945 a report on this topic was prepared **by a subcommittee of the War Policy Committee which consisted of W. L. Hart (Chairman), Saunders MacLane, and C. B. Morrey, Jr. The report, which was approved by the War Policy Committee, the Council of the American Mathematical Society, and the Board of Governors of the Mathematical Association of America, was published in full in the *Bulletin* of the American Mathematical Society. Chairman Marshall H. Stone, of the War Policy Committee, has furnished this summary statement.**

universal, compulsory military training in time of peace—it is clearly of the first importance that no program detrimental to the scientific and technological vigor of the Nation should be adopted. The report deals frankly and in detail with this vital segment of the problem now before Congress. In offering the recommendations of the report as a professional contribution to the current discussion, the War Policy Committee hopes to render a modest public service within the natural sphere of its activity.

INTRODUCTION

Congress is currently considering legislation to establish universal military service in peacetime. It is the purpose of this report to examine the implications of such legislation for those phases of our national life about which mathematicians may speak with special knowledge. It is natural, however, that some of the statements made should reflect a broad educational concern rather than a strictly professional one.

GENERAL RECOMMENDATIONS

This report does not deal directly with the basic question: "Should the United States have universal military training in peacetime?" We believe, however, that this question should be decided only in the light of a thorough study by a Presidential commission representing not only the armed services but also other important national activities, including science, industry, and technology.

SPECIFIC RECOMMENDATIONS

The report concerns itself chiefly with the equally important question: "If Congress is to pass a universal military service act, what provisions should be included in order that the greatest benefit should be obtained for the Nation as a whole and for the young men who will perform the service?" From our recent experiences with the development of new weapons and tactics, it is clear that science is a fundamental factor in the military power of the Nation; and that, as a result, long-range military planning requires that young men be encouraged to prepare themselves in basic scientific and mathematical knowledge and to acquaint themselves with the ways in which this knowledge can be applied in time of war or national emergency. Furthermore, it is equally important that the peacetime military program should not interfere with plans to overcome the present dangerous shortage of scientists and technologists and to provide for a continuous generous supply in such essential categories of trained citizens in the future. Our democratic principles bring out clearly the unwisdom of granting individual exemptions as a means of safeguarding the development of science and technology. It is therefore recommended at the outset that:

(1) No outright exemptions from universal military service should be requested.

The appropriate way to harmonize military training with our scientific and technological needs lies rather in the direction of recognizing frankly that military training includes not only the usual routine military activities but also various other highly technical forms of training equally essential for the development of military strength. In particular, a program of military training could, with great advantage, include appropriate advanced types of service in which the special aptitudes of the small but important group with a bent for mathematics, the physical sciences, or engineering are employed and developed. Accordingly, the next recommendation reads:

(2) The required military service should be highly differentiated in accordance with the aptitudes and training of the young men involved, with emphasis on exceptional differentiation for those with the greatest technical abilities.

In order that young men with the prerequisite aptitudes should have opportunities to prepare themselves for such differentiated service, the possibility of deferments must be considered. More important still is the problem of preventing the atrophy or diversion of the scientific talents of any appreciable proportion of the Nation's youth on account of ill-timed interruptions in scientific training occasioned by the military program. This problem, too, would be met most easily and directly by a policy of deferments. It has been estimated that the small but significant body of scientists and engineers must be recruited annually from a group of high school graduates including around 20,000 boys of high mathematical and scientific aptitude. In order to safeguard the training and development of these essential young men, it is therefore recommended that:

(3) A system for deferring the term of military service should be instituted so that gifted young men might prepare themselves for advanced varieties of differentiated service before entering the armed forces.

(4) The possibilities for technical varieties of differentiated service should be canvassed by a joint civilian and military board. The resulting training programs with the corresponding academic prerequisites should be well advertised among high school boys, their parents, and the teachers and administrators in the secondary field.

Indeed, a deferment policy so liberal as to permit continued postponement of the term of military service until completion of work for the Ph.D. would be entirely justifiable, it is thought, in the case of extremely gifted young men, who could then perform their service in the various laboratories, research divisions, arsenals, and other technical agencies of the armed forces. In addition to a wise policy of deferment, the encouragement and development of youthful scientific talent under the circumstances which would be produced by universal compulsory military training make necessary a policy of strengthening scientific training both before and during the term of service. To this end, added efforts should be made in the field of secondary education to teach the better students as much mathematics and physical science as possible; and young men in military service should be given every encouragement, including the payment by government of the necessary fees, to extend their formal education by pursuing correspondence courses, including courses at college level. The report therefore recommends that:

(5) If universal military service is adopted, in the field of secondary education particular attention should be paid to increasing the efficiency and quantity of instruction given in mathematics and physical science to the students of better than average ability.

(6) The armed forces should encourage young men to continue their education during military service by taking correspondence work through regular school channels, and should pay the costs of such study if a man carries it through diligently.

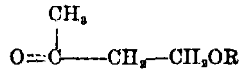
Technical Papers

Synthesis of Biologically Active Vitamin A Substances[1]

Nicholas A. Milas[2]
Massachusetts Institute of Technology

The structure of vitamin A was definitely established from degradation and other experiments as far back as 1931 by Karrer (*4*) and was later confirmed by Heilbron (*2*) and others. On the basis of this knowledge, several synthetic methods, claiming the synthesis of vitamin A itself and some of its derivatives, have been published in various countries during the last decade. Of these, only one—that published in Germany in 1937 by Kuhn and Morris (*6*)—claims to have produced a biologically active product. Subsequent attempts to reproduce this synthesis in other countries (*5*) as well as in Germany (*8*) have been entirely unsuccessful.

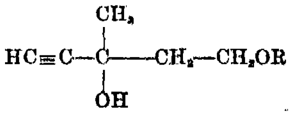
The German method was one of the first we investigated, but our failure to obtain one of the key intermediates, β-ionylidene acetaldehyde, forced us to abandon this method early in 1940. Since then, we have investigated several alternative syntheses (*7*). In one of these syntheses, which led to biologically active vitamin A substances, the aldehyde (I), originally prepared by Ishikawa and Matsuura (*3*) from β-ionone and ethyl chloroacetate, was condensed with lithium acetylide in liquid ammonia at -60 to -70° C. to give the acetylene carbinol (II) in about 65 to 70 per cent yields. A condensation of this product, via the Grignard reaction, with the ketone (III), in which R may be either an alkyl or an acyl group



$$O{=}\overset{\displaystyle CH_3}{\overset{|}{C}}{—}CH_2{—}CH_2OR$$

(III)

depending upon whether an ether or an ester of vitamin A is wanted, produced the acetylene glycol (IV) in about 70 to 80 per cent yields. The acetylene glycol ethers have also been synthesized in higher yields by condensing, again via the Grignard reaction, 3-methyl 3-hydroxy 5-alkoxy pentyne-1 (V) with the aldehyde (I). Unfortunately, the corresponding acetylene glycol esters cannot be obtained easily by this reaction. In the next step of the synthesis, the



$$HC{\equiv}C{—}\underset{\displaystyle OH}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}{—}CH_2{—}CH_2OR$$

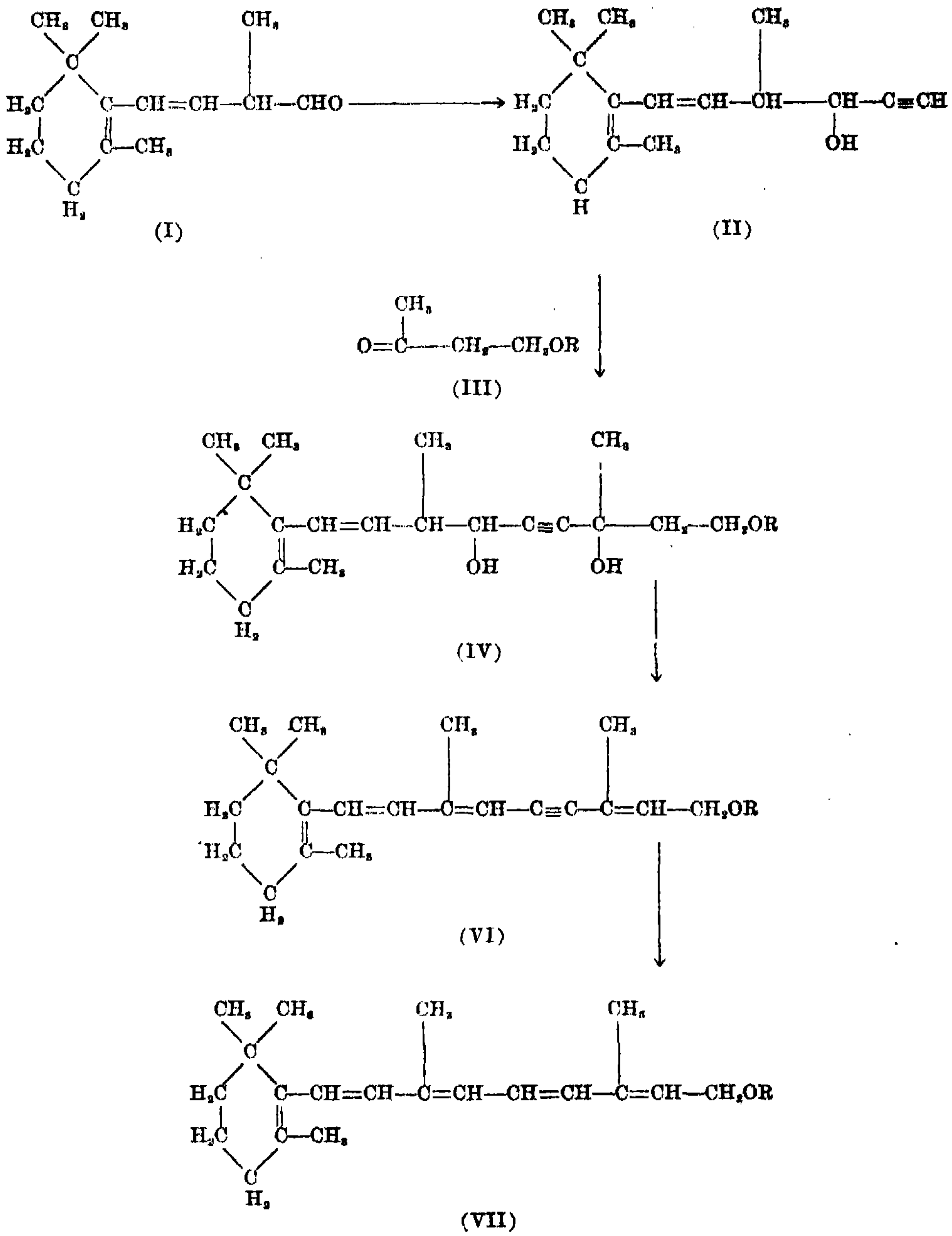
(V)

acetylene glycol was dehydrated, using *p*-toluene sulfonic acid as the dehydrating agent, to produce the polyvinyl acetylene (VI), which, when selectively hydrogenated, yielded biologically active ethers or esters of vitamin A (VII), depending upon whether R was an alkyl or an acyl group.

---

[1] Presented in part before the North Jersey Section of the American Chemical Society, 9 April 1945; the AAAS-Gibson Island Conferences, 23 July 1945; and in a Vitamin A Symposium sponsored by the Northeastern Section of the American Chemical Society, 10 January 1946.

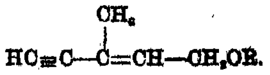
[2] The author takes this opportunity to gratefully acknowledge the assistance of (Miss) M. A. Campbell, R. O. Edgerton, (Mrs.) J. Gladding, F. X. Grossi, J. N. Ingraham, S. W. Lee, (Mrs.) A. R. Lowry, N. S. MacDonald, (Miss) S. Z. Paul, (Mrs.) R. Pitt, J. T. Plati, E. Sakal, (Miss) Z. Weiss, H. C. Wohlers, and H. F. Wright.



(I) (II) (III) (IV) (VI) (VII)

The final products were also synthesized by following a slightly different set of reactions. The acetylene glycol (IV) was first selectively hydrogenated to an olefinic glycol (VIII), which was then converted to the dichloride (IX), and the latter dehydrochlorinated with alcoholic potash to the corresponding ethers of vitamin A when R was an alkyl group and to the vitamin A alcohol itself when R was an acyl group.

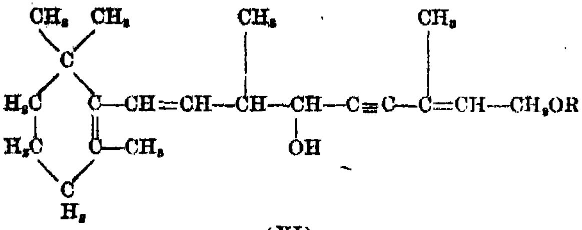
In order to obtain additional data on the synthetic ethers of vitamin A and to avoid going through the acetylene glycol (IV), a third, slightly different method was developed. The acetylene carbinol (V) was first dehydrated to produce 3-methyl 5-alkoxy vinyl acetylene (X),



$$HC\equiv C-\overset{CH_3}{\overset{|}{C}}=CH-CH_2OR.$$

(X)

When this was condensed, via the Grignard reaction, with the aldehyde (I), the acetylene carbinol (XI) was produced in very good yields. This carbinol was easily dehydrated to the polyvinyl acetylene (VI), from which the vitamin A ethers were obtained by selective hydrogenation. The acetylene carbinol (XI) has also been selectively hydrogenated to the corresponding polyene carbinol (XII), which was advantageously dehydrated to give good yields of vitamin A ethers.


(XI)

The final products produced by the three synthetic routes outlined above are identical whenever R is the same. Ultimate analysis, unsaturation, and molecular weight determinations agreed well with the expected values for the structural formula (VI). The absorption spectrum in the ultra-violet has a well-defined maximum similar to that observed for the corresponding natural vitamin A substances, except that it is slightly displaced towards the ultraviolet region by about 30 to 50 A. The synthetic ethers of vitamin A give a purplish blue color with antimony trichloride which exhibits both the 6,200-A. and the 5,800-A. bands characteristic of natural vitamin A. The vitamin A esters and the alcohol itself give a deep blue color exhibiting the same bands.

Biologically, all the synthetic products which are represented by the final structure (VI) have been found active by Prof. Harris, of the Nutritional Laboratories of this Institute. Furthermore, the biological effect on rats has been found to be identical with that produced by cod-liver oil. The potency, however, was much lower than that generally accepted for the purest sample of natural crystalline vitamin A (3,500,000 U.S.P. vitamin A units per gram). For the synthetic vitamin A methyl ether, for example, Prof. Harris reported indications of activity in the order of 500,000 to 1,000,000 U.S.P. vitamin A units per gram and reproducible activity of the order of 50,000 to 100,000 U.S.P. units per gram. Several other laboratories have tested our synthetic products and confirmed, within certain limits of variation, the lower potencies reported by Prof. Harris. Although the potency of the synthetic products is much lower than that of the purest natural crystalline vitamin A, the biological activity cannot be disputed and, if compared to commercial products, it is of the order of 50 to 100 times that of ordinary cod-liver oil, one of the chief sources of vitamin A.

If the biological potency of the synthetic products is much lower than that of the corresponding natural products, one can raise the question whether they are identical. We have devoted a considerable amount of our time in an attempt to answer this question. Our most recent results seem to indicate that the synthetic products are mixtures of stereoisomers of the *cis-* and *trans-* type, exceedingly difficult to separate and some of which are probably completely devoid of biological activity. This is not surprising, for even the natural vitamin A, when first isolated by Karrer (1931), presumably in a chemically "pure" form, had a considerably lower potency than the crystalline vitamin A recently prepared by Baxter and Robson (*1*). Was Karrer's sample a mixture of stereoisomeric forms, some of which were biologically inactive? This question cannot be answered until the stereochemical configuration of vitamin A is known. Merely speculating from analogies with certain carotenoids may lead to a false conclusion. Some organic chemists are unwilling to admit that *cis-* and *trans-*isomerism is even present in molecules which have more than three double bonds in conjugation. Work along these lines is exceedingly difficult and time-consuming, but it is quite essential because of its connection to the important problem of specificity of vitamin A.

References

1. Baxter, J. G., and Robson, C. D. *J. Amer. chem. Soc.*, 1942, **64**, 2407.
2. Heilbron, I. M., *et al.* *Biochem. J.*, 1932, **26**, 1194.
3. Ishikawa, S., and Matsuura, T. *Sci. Rep. Tokyo Bunr. Daigaku*, 1937, **A3**, 173.
4. Karrer, P., *et al.* *Helv. Chim. Acta*, 1931, **14**, 1036, 1431; 1933, **16**, 625.
5. Karrer, P., *et al.* *Helv. Chim. Acta*, 1940, **23**, 284; Krauze, P., and Slobodin, Y. M. *J. gen. Chem.* (USSR), 1940, **10**, 907; Heilbron, I. M., *et al.* *J. chem. Soc.*, 1942, 727.
6. Kuhn, R., and Morris, C. J. O. R. *Ber.*, 1937, **67**, 1735.
7. Milas, N. A. U. S. Pats. 2,369,156–2,369,168 inclusive, 13 February 1945; U. S. Pats. 2,382,085–2,382,086, 14 August 1945.
8. ———. Chemical warfare service report on developments of German chemical industry. *Chem. Eng. News*, 1945, **23**, 1521.

Treatment of Severe Erythroblastosis by Simultaneous Removal and Replacement of the Blood of the Newborn Infant[1]

Harry Wallerstein, M. D.

585 West End Avenue, New York City

Although considerable information has been accumulated concerning the mechanisms involved in the causation of erythroblastosis fetalis, the established treatment by repeated transfusions of Rh- blood has thus far not been entirely successful. Many babies with erythroblastosis have died of the disease, though no evidence of severe anemia existed. A factor of toxemia, possibly arising from the stromal substance of the lysed red blood cells, undoubtedly plays an important part in the fatal outcome in these cases. The manifestations of such a toxemia are found in kernicterus and in the evidences of kidney and liver damage that may exist. It was felt that the mere administration of Rh– blood did not meet the problem in all cases. It did seem desirable to remove the known *Rh+ blood of the infant and to replace it* with Rh– blood. Such a procedure would either minimize or entirely prevent the action of the hemolytic end products upon the liver, kidneys, and brain ganglia.

---

[1] Preliminary report from the Laboratories of the Queens General Hospital, Jamaica, Long Island, and from the Department of Hematology, Jewish Memorial Hospital, New York City.

A technique has been evolved to carry out this purpose to a considerable degree, without subjecting the child to the hazard of shock due to exsanguination. This is accomplished by the simultaneous withdrawal of the Rh+ blood from the sagittal sinus and the administration of Rh– blood through a cannulated vein.

It can be shown mathematically that if a continuous transfusion and withdrawal is carried out for 60 minutes, if the mixing is considered the equivalent of instantaneous, and if the baby's blood volume is approximately 250 cc., only 36.7 per cent of the original blood will remain. To test this hypothesis, we duplicated the conditions by the use of an aspirator bottle containing 250 cc. of tenth normal HCl with a pipette for the constant admission of distilled water, at a rate which was equal to the loss of the HCl in the aspirator bottle, into a measuring cylinder. A stirrer was kept within the aspirator bottle. When 250 cc. of fluid from the aspirator bottle was collected in the cylinder, a sample of the liquid remaining in the aspirator bottle was titrated and showed .0367 normal HCl.

A variation of this procedure, whereby 50 cc. of blood are removed from the baby and then an equivalent amount administered in alternation, can be shown arithmetically to permit of an exchange that leaves behind 80 cc. of the original 250 cc. Inasmuch as the child is given approximately 100 cc. of Rh– blood over and above that withdrawn, the dilution factor permits of a reduction of the original Rh+ blood to 25 per cent of the original volume. The typing of the blood cells removed at the start and at the end of the exchange confirms the fact that only 25 per cent of the original Rh+ cells remain after such a procedure.

On the basis of the above, this technique has been carried out on three separate infants since May 1945, with immediate improvement in their conditions and eventual recovery without further therapy. It will be understood that, because of the dramatic nature of the procedure, only infants who were most severely ill with erythroblastosis were submitted to this routine. These included a twelfth pregnancy of a mother with eight previous erythroblastotic babies and stillbirths, a second case with an icterus index of 625, and a third infant showing marked toxicity and spasm.

The results to date justify a more widespread use of this method in the combating of the severe cases of erythroblastosis fetalis.

The Apparent Antagonism Between Vitamin A and Carotenoids in the Fowl

Max Rubin and H. R. Bird
Bureau of Animal Industry, Beltsville Research Center, Beltsville, Maryland

Hammond and Harshaw (*2*), working at the Beltsville Research Center, showed that there was some material in fortified cod-liver oil which interfered with the deposition of xanthophyll in the shanks and skin of chicks. Mattson and Deuel (*5*) reported that there was interference in the carotenoid metabolism of growing chickens when they were given daily doses of shark-liver oil to supply 9,300 I.U. of vitamin A. Deuel, *et al.* (*1*) fed 0.01 per cent to 2.42 per cent of shark-liver oil to hens to supply from 1,000 to 200,000 I.U. of vitamin A per pound of feed. There was a progressively decreasing quantity of pigment in the

TABLE 1

Supplement to basal diet	Approx. I.U. of vitamin A per 100 grams of diet	Av. pigment score	Range of scores
	First Experiment		
(1) None	.....	16.0	15.0–17.0
(2) 0.045 per cent vitamin A concentrate	9,000	6.4	3.0–10.0
(3) 5.4 mg. crystalline carotene per 100 grams of diet	9,000	15.2	14.0–16.0
(4) 3.0 per cent vitamin A and D oil No. 1	9,000	7.0	4.0–12.0
(5) 0.140 per cent shark-liver oil	3,000	12.2	7.0–16.0
(6) 3.0 per cent vitamin A and D oil No. 2	8,000	13.4	8.0–16.0
(7) 3.0 per cent irradiated* A and D oil No. 2	.....	14.2	10.0–16.0
(8) 3.0 per cent shark-liver oil	60,000	4.6	4.0– 6.0
	Second Experiment		
(1) None	.....	15.7	15.0–17.0
(2) 0.4 per cent ethyl laurate	.....	16.4	16.0–17.0
(3) 0.4 per cent ethyl laurate and 3.51 mg. crystalline vitamin A alcohol per 100 grams	9,000	11.4	6.0–16.0
(4) 0.053 per cent vitamin A concentrate	9,000	11.0	3.0–16.0
(5) 0.492 per cent shark-liver oil	9,000	10.2	4.0–17.0

* Irradiated with ultraviolet light for 16 hours to destroy vitamin A.

egg yolks as the shark-oil content of the diet was increased. These workers concluded that the vitamin A interfered with the carotenoid metabolism in both growing chickens and laying hens. It seemed desirable to subject this conclusion to a more critical test by feeding, respectively, crystalline vitamin A and fish oil in which the vitamin A had been destroyed.

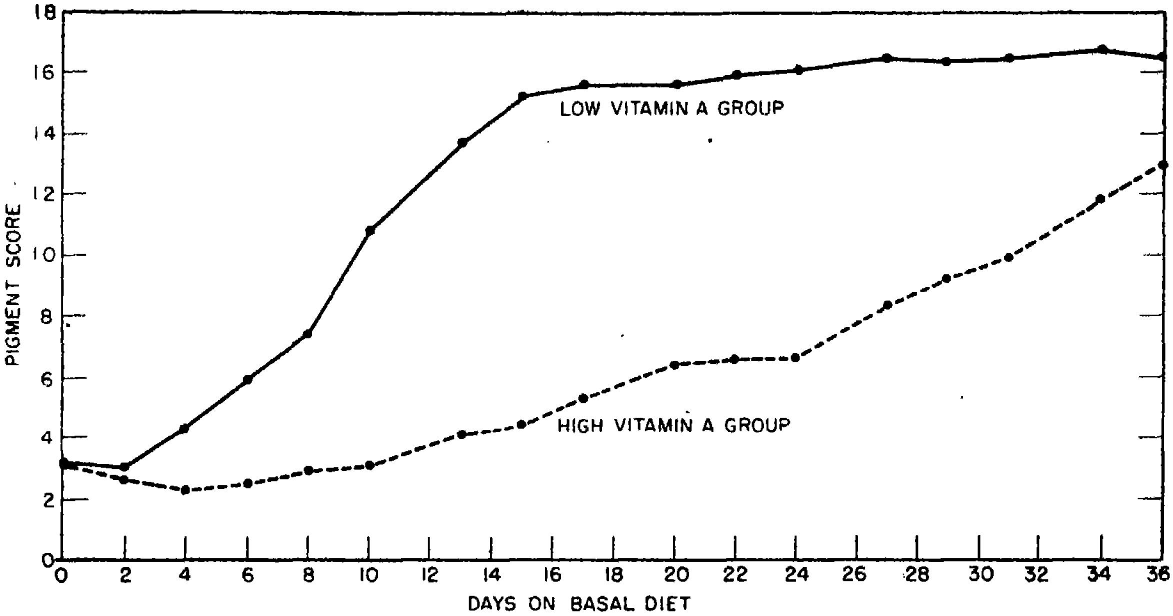


Fig. 1

Hammond and Harshaw suppressed pigmentation by feeding 3 per cent of fortified cod-liver oil which contributed 9,000 I.U. of vitamin A per 100 grams of diet. Therefore, two experiments were planned in which various supplements were fed to supply this level of vitamin A. These experiments are summarized in Table 1. The basal diet was Diet C of Hammond and Harshaw, containing 40 per cent yellow corn, 10 per cent corn gluten meal, and 3 per cent alfalfa leaf meal as sources of carotenoid pigments. The experimental diets were fed to groups of 25 chickens during the first six weeks of life, at the end of which time the degree of shank pigmentation was determined by matching the color of the shanks with the Heiman-Carver (*3*) color rotor.

In the first experiment, all groups fed 9,000 or more units of vitamin A per 100 grams of diet showed considerably less pigmentation than the control, except for the group fed carotene. The vitamin A concentrate fed to Group 2 was at least as effective as the vitamin A and D oil fed to Group 4. Compared to the effect of these two supplements the effect of the irradiated oil, which was free of vitamin A according to the antimony trichloride test, was very slight.

In the second experiment the average pigment scores of the chicks fed vitamin A supplements were not as low as in the previous test. However, it is evident that crystalline vitamin A alcohol suppressed pigmentation as effectively as did the vitamin A of the concentrate or of shark-liver oil.

Mattson and Deuel suggested that a high intake of vitamin A might lead to development of a nonspecific enzyme system capable of destroying not only vitamin A but also carotene and carotenoids. However, Hickman (*4*) has found that "*in vitro* experiments show that vitamin A is a specific pro-oxidant for beta-carotene, lycopene and probably zeaxanthin."

It was of interest to determine whether this pro-oxidant effect is largely confined to the intestinal tract in chickens or whether bodily stores of vitamin A are capable of exerting the same effect in the blood stream or tissues.

During the first six weeks of life chicks were fed diets which were deficient in carotenoid pigment. The diet of the first group was supplemented with enough vitamin A to maintain good growth. The second group was supplied with 100,000 U.S.P. units of vitamin A per 100 grams of diet, a very large excess. Beginning at six weeks of age, and for 36 days thereafter, both groups were given the basal diet used in the previous experiments. Their shanks were judged for degree of pigmentation, and two chicks from each group were sacrificed for determination of carotenoid and vitamin A in the livers. The analyses for the low vitamin A group showed 1.5 μg. of xanthophyll and 1,112 B.U. of vitamin A per gram of liver, and the analyses for the high vitamin A group showed 1.4 μg. of xanthophyll and 5,406 B.U. of vitamin A.

The shanks were scored three times each week, and the average pigment scores for each group were plotted against time (Fig. 1). The chicks with the lower vitamin A stores soon began to accumulate yellow pigment in their shanks. The group with larger vitamin A stores accumulated pigment in their shanks at a considerably slower rate, indicating that the effect of vitamin A is exerted in the blood stream or tissues or both.

It has also been observed that large quantities of vitamin A in the diet or stored in the body of the hen have an inhibiting effect on the pigmentation of egg yolk.

The results of some preliminary work on the liver analyses of chicks fed high levels of vitamin A indicate that there is a simultaneous destruction of the carotenoid pigment and vitamin A. This phase of the study is being continued.

SUMMARY

These experiments show that the pigmentation-suppressing factor in fish-liver oils is vitamin A. Carotene fed at comparable levels does not exert a suppressing effect on pigmentation. Inhibition of pigmentation takes place when there is a sufficiently large bodily store of vitamin A; it is not exclusively an intestinal phenomenon.

References

1. DEUEL, H. J., JR., HRUBETZ, M. C., MATTSON, F. H., MOREHOUSE, M. G., and RICHARDSON, A. *J. Nutrition*, 1943, **26**, 673.
2. HAMMOND, J. C., and HARSHAW, H. M. *Poultry Sci.*, 1941, **20**, 437.
3. HEIMAN, V., and CARVER, J. S. *U. S. Egg Poultry Mag.*, 1935, **41**, 40.
4. HICKMAN, K. Personal communication.
5. MATTSON, F. H., and DEUEL, H. J., JR. *J. Nutrition*, 1943, **25**, 103.

The Effect of Tocopherols in Preventing Gastric Ulcers in Rats[1]

JAMES L. JENSEN[2]
Research Laboratories, Distillation Products, Inc.

Although the anomalies encountered in vitamin A bio-assay have troubled investigators for many years, it has not been generally recognized that rats which are deficient in vitamin A are nearly always afflicted with stomach ulcers. In this note it is reported that inclusion of extra vitamin E in the diet has completely prevented the occurrence of such ulcers.

The experiments which revealed this relationship were undertaken to find out whether alcohol affected the utilization of vitamin A by the rat. In addition to a vitamin A-deficient diet, one group of rats was given a minimal dose of vitamin A daily (.57 μg.) and other groups, vitamin A plus either ethyl alcohol or vitamin E, as pure d,α-tocopherol, or both alcohol and vitamin E.

Table 1 shows the supplements given, the weight gains, and the percentage of rats having ulcers.

Severe gastric lesions were noticed upon autopsy of the vitamin A-deficient rats. The lesions, described as local circumscribed metaplasia of the surface epithelium,[3] were located in the fore-stomach and especially near the junction of the cardiac and pyloric portions. They ranged from pin-point size to craters 7 mm. in diameter, and some of them had been bleeding.

TABLE 1

EFFECT OF VITAMIN E, WITH AND WITHOUT ALCOHOL, ON GROWTH AND ULCER PRODUCTION OF VITAMIN A-DEPLETED RATS RECEIVING .57 μg. OF VITAMIN A DAILY*

Group No.‡	Supplement†		Gain in body weight after 48 days	Incidence of gastric ulcers
	Alcohol as 95% C_2H_5OH	d,α-Tocopherol		
	(mg.)	(mg.)	(grams)	(%)
1	0	0	64	67
2	0	0.5	79	0
3	0	5.0	77	0
4	64	0	41	40
5	64	0.5	63	0
6	64	5.0	67	0
7	128	0	29	80
8	128	5.0	57	10

* The basal diet was fed ad libitum and contained: casein, vitamin-free, 18%; starch, 65%; salt mixture, U.S.P. #2, 4%; yeast, 8%; lard, 5%; vitamin D in the lard to furnish 30 units/10 grams of diet.

† In addition to .57 μg. vitamin A as a natural ester concentrate.

‡ The first group contained 15 rats; the others, 10 each.

Vitamin E fed to rats receiving minimal doses of vitamin A with and without alcohol supplementation protected the rats from ulcer formation, except those which were fed the larger dose of alcohol. Ulcers were present in many rats which did not receive the vitamin E supplement.

Since ulcers were prevalent among the vitamin A-deficient rats, and yet were nearly always absent when tocopherols were given, it may be tentatively assumed that the vitamin A-sparing action of the tocopherols was a factor in preventing the lesions. Alcohol, however, had an opposite effect on vitamin A utilization. The drop in weight gain from 64 to 29 grams (Groups 1 and 7) when comparing a diet without alcohol and one with alcohol may be used as a measure of the deleterious effect of alcohol on vitamin A. A larger tocopherol supplement for the group receiving the

---

[1] Communication No. 77.

[2] At present Post Nutrition Officer, Fort Knox, Kentucky.

[3] Dr. Karl E. Mason, University of Rochester School of Medicine, very kindly examined some of these lesions grossly and microscopically.

most alcohol might have lowered the incidence of gastric lesions.

Other workers have indicated a relation between vitamin A and ulcers. Fredericia, *et al.* (*1*) used a diet low in vitamin A and tocopherol and, after periods varying from 10 to 53 weeks, observed an 80-per cent incidence of gastric ulcers. In a similar group, which was fed the same diet with butterfat (containing vitamin A) instead of oxygenated lard, the incidence of ulcers was only 18 per cent. Vitamin A deficiency was therefore considered a principal factor in causing the ulcers, although other factors, as yet unnkown, may have played an important part. Pappenheimer and Larimore (*2*) found a 55-per cent ulcer formation in rats on a vitamin A-deficient diet.

If a vitamin A deficiency predisposes rats to ulcers, then a vitamin A-sparing substance such as tocopherol calls for further experimental work in their prevention. This function of vitamin E and also of other dietary factors is the subject of further studies to be reported later.

References

1. Fredericia, L. S., Gudjonsson, S., Vintrup, B., Clemensen, S., and Clemensen, J. *Amer. J. Cancer*, 1940, 39, 61.
2. Pappenheimer, A. M., and Larimore, L. D. *J. exp. Med.*, 1934, 40, 710.

Identification of Small Amounts of Organic Compounds by Distribution Studies. IV: Use of a Solid Phase

Lyman C. Craig, Calvin Columbic, Harold Mighton, and Elwood Titus

The Rockefeller Institute for Medical Research
New York City

Countercurrent processes for fractionation such as fractional distillation, chromatographic adsorption, and liquid-liquid extraction are generally complicated processes which have been best described by rather involved mathematical treatment (*7*). With small-scale work, however, a considerable amount of simplification can be achieved, at least in liquid-liquid extraction, by the proper selection of conditions and by using a discontinuous process.

Previously reported studies (*3, 4*) have shown the advantages to be derived from the standpoint of quantitative investigation when transfers can be made in actual discrete units where an opportunity is offered to place all the material to be distributed in a single tube or unit at the start of the operation. This allows the whole process to be theoretically and precisely followed by means of the proper mathematical expansion when the substance involved does not show too great a shift of partition coefficient over the range of concentration used. Thus, for any pure substance the theoretical distribution may be calculated, and if experimentally a serious deviation is found for an unknown preparation of the substance, this would constitute good evidence for some degree of inhomogeneity. Moreover, this deduction can be checked readily by determining the partition coefficient of the material found in the tube where the greatest deviation from the theoretical occurs and comparing it with the value found for the pure substance.

This general procedure has proven particularly useful for studying homogeneity in basic compounds such as the synthetic antimalarials (*4*). In general, these substances do not give crystalline derivatives suitable for precise characterization by classical organic methods but do give highly specific partition coefficients in that they appear to offer wide differences even from those of closely related substances, when one of the phases is an aqueous phase in which the pH is held constant by means of a buffer (*2*). The same approach should also hold true for the characterization of acids (*6*), although somewhat more association in one of the phases might be expected with a resultant shift of partition coefficient with concentration.

In view of the similarity of countercurrent extraction and chromatographic principles (*5*), a further logical step to be taken in the development of the method of "Countercurrent Distribution" is the replacement of one of the liquid phases by a solid phase. This would bring into play the well-known specificity of the adsorption isotherm which is the basis for the striking separations often obtained with the chromatogram. Substitution of a solid phase for one of the liquid phases should not entail too great a change in the design of the countercurrent distribution machine in order to make its use practical. With this objective in mind a few simple experiments have been carried out preliminary to the expenditure of time and effort involved in the design of the more precise equipment required for a much larger number of transfers.

For simplicity in making the process directly analogous to the liquid-liquid type of distribution the degree of adsorption may be visualized in terms of a constant similar to that of a partition coefficient. This constant, A, may be defined as the percentage of the material found in the liquid divided by the percentage adsorbed by the solid which is in equilibrium with the liquid. Thus, if a known weight of a substance to be partitioned is used, $A = \frac{CV}{W-CV}$, where C = concentration of solute, V = volume of solvent, and W = total weight of solute taken.

Since equal volumes of the solvent and equal weights of the solid phase are involved in each transfer, the constant, A, could be directly substituted for K in the mathematical treatment developed for the liquid-liquid type of distribution (*3*). The proportions of liquid and solid as well as the concentration of the solute could be chosen so that the constant, A, would show the smallest shift with change of concentration of the solute. The shift would naturally differ (*1*) with each system chosen as well as the solute to be studied and might be expected to be larger than in the case of most liquid partition coefficients.

In a few preliminary experiments with Brockmann's alumina (Merck) as the adsorbent, cyclohexane as the solvent, and chrysene as the solute, it was found that the constant, A, approximated 1.7 for 10 mg. of chrysene dissolved in 20 cc. of cyclohexane and equilibrated with 0.7 gram of alumina at room temperature. At a concentration of 2 mg. in 20 cc. of solvent, A approximated 1.3, and at a concentration of 0.2 mg. in 20 cc. it approximated 0.7. This is a shift which is not materially greater than those we have encountered in many of the liquid-liquid partition coefficients (*4*) without serious impairment of the method.

With these data at hand, an experiment was set up in which 11 tubes, numbered 0 to 10, were used. Seven-tenths gram of alumina was added to each of the first 10 tubes, but No. 10 was left empty. The alumina in each tube was treated with cyclohexane and the excess liquid poured off the top. Fifteen milligrams of chrysene dissolved in 20 cc. of cyclohexane (heated to cause solution and quickly cooled to room temperature) were introduced into the 0 tube. After two minutes of shaking for equilibration the solution was decanted into Tube 1. Twenty cubic centimeters of cyclohexane were then added to Tube 0 and both tubes equilibrated. The solution in Tube 1 was then decanted into Tube 2, while that of Tube 0 was transferred to Tube 1. Fresh solvent was added to Tube 0, and all three were shaken. This process was repeated progressively until all the tubes were filled. This completed the distribution.

A mixture of 2 cc. of methanol and 5 cc. of isopropyl ether was then added to each tube for complete elution of the adsorbed material, and the total amount of hydrocarbon in each tube was determined spectroscopically by means of the Beckmann quartz spectrophotometer. The weight found in each tube is shown graphically in Curve 1 of Fig. 1. This curve compares favorably with the type of curve encountered in liquid-liquid countercurrent distribution in which there has been a similar shift of K with concentration (*4*).

Anthracene was investigated in the same system and was found to have a coefficient, A, of approximately 7. Fifteen milligrams of this hydrocarbon distributed in exactly the same way as was chrysene gave the result shown in Curve 2. The maximum of both Curves 1 and 2 occurs at the positions on the graph calculated by the relationship of $N = n\left(\frac{A}{A+1}\right)$ given in the previous publication (*3*).

A mixture of 15 mg. of each hydrocarbon was now distributed. Though certain of the tubes contained mixtures in which a considerable portion of both hydrocarbons was present, the amount of each present in any one tube could be calculated from their respective extinction coefficients at those wavelengths for which the extinction of the one is relatively small in comparison to the other, and by appropriate subtraction. In this manner the distribution of anthracene was found to be that given in Curve 3, while that of chrysene was found to be that of Curve 4. Both showed a small deviation from that of the band obtained when the pure compound was distributed, but this might well be due to a slight tendency to associate.

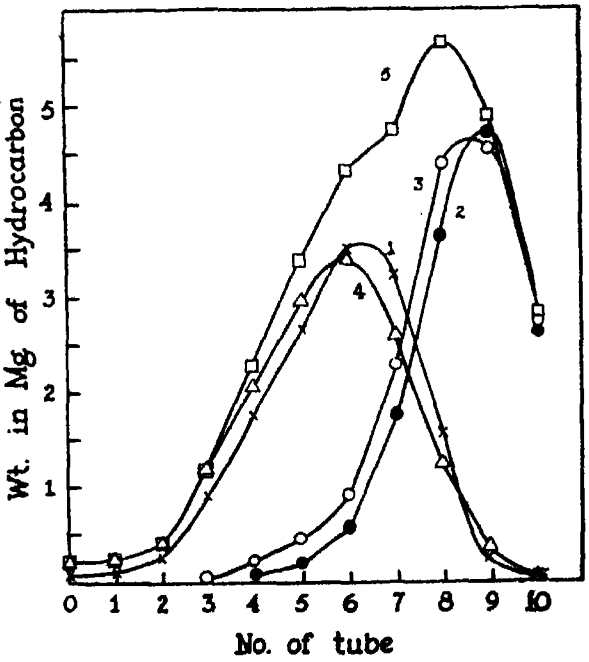


FIG. 1. × = curve for chrysene, ● = curve for anthracene, △ = curve for chrysene in mixture, ○ = curve for anthracene in mixture, □ = sum of curves for chrysene and anthracene in mixture.

The sum of the two curves gives Curve 5, which would be that to be expected had the analysis of each tube been done by evaporating to dryness and weighing the residue. The approximate percentage of each hydrocarbon in any one of the tubes can be calculated readily from the data, and the degree of separation in each tube is at once evident. Upon evaporation to dryness Tube 4 gave 2 mg. of hydrocarbon which melted at the proper place for chrysene, and Tube 10 gave 2.8 mg. of hydrocarbon which melted at the proper place for anthracene.

These preliminary data would thus appear to show that a solid phase can be substituted directly for one of the liquid phases of "Countercurrent Distribution," provided an adsorbent is chosen which has an adsorption isotherm within the proper range and of the proper type. Certain advantages at once become evident in the procedure. Most of these have previously been mentioned (7) and scarcely need to be repeated here except as they relate to the customary chromatographic procedure.

It would appear that the determination of the coefficient, A, may offer a rapid and convenient method for selection of the most promising system from among the large number of possibilities.

Secondly, the physical state of the adsorbent, such as size and shape of the particles, should be relatively unimportant in the procedure as outlined. With the chromatograph a certain size and uniformity is usually required in order that the packing may be homogeneous and at the same time yield the desired rate and uniformity of flow.

Just as in the case of the liquid-liquid type, the shape of the curve may give a suggestion at once as to the homogeneity of the preparation when a single substance predominates. If a mixture is present, it may suggest the number of components or give at least a hint in regard to whether or not further work with the particular system is advisable in order to obtain resolution of the mixture.

It would appear probable that the use of a solid with adsorptive properties in place of one of the liquid phases may greatly extend and widen the range of application of "Countercurrent Distribution." It is therefore our intention to make this approach part of our future study and to devise equipment suitable for achieving large numbers of transfers.

References

1. Cassidy, H. G. *J. Amer. chem. Soc.*, 1940, **62**, 3073.
2. Craig, L. C. *J. biol. Chem.*, 1943, **150**, 33.
3. Craig, L. C. *J. biol. Chem.*, 1944, **115**, 519
4. Craig, L. C. *J. biol. Chem.*, 1945, **161**, 321.
5. Martin, A. J. P., and Synge, R. L. M. *Biochem. J.*, 1941, **35**, 1358.
6. Murray, C. D. *J. biol. Chem.*, 1923, **56**, 569.
7. Vartebessian, K. A., and Fenske, M. R. *Ind. eng. Chem.* (Ind. ed.), 1936, **28**, 1353.

Science Legislation

The Senate and S. 1850

Howard A. Meyerhoff
Executive Secretary, AAAS, Washington, D.C.

AS ANNOUNCED IN THE 3 MAY ISSUE OF *Science*, the Council of the American Association for the Advancement of Science voted overwhelmingly to support the Kilgore-Magnuson bill creating a National Science Foundation. The final vote is 230 to 10, which means that over 90 per cent of the Council members voted. The problem now is to convince the members of Congress that S. 1850 not only meets the basic needs of science and scientists, but also will, if enacted, perform a public service of the first importance.

At the St. Louis meetings of the Executive Committee and the Council of the Association, James B. Conant, as president of AAAS, was asked to serve as the chairman of a special committee, empowered to take such steps as may be deemed desirable to assure passage of the bill. The following men have been asked to serve as members of this committee: Detlev W. Bronk, of the University of Pennsylvania; A. J. Carlson, of the University of Chicago; Magnus I. Gregersen, of the College of Physicians and Surgeons, Columbia University; Ernest O. Lawrence, of the University of California; Howard A. Meyerhoff, executive secretary of AAAS; E. C. Stakman, of the University of Minnesota; and Charles Allen Thomas, of the Monsanto Chemical Company, St. Louis.

The bill was placed upon the Senate calendar very quickly after it was reported out by the Committee on Military Affairs (*Science*, 1946, **103**, 382). However, it was passed over on 12 April, when it should logically have been discussed on the Senate floor. It is the hope of the bill's senatorial sponsors that it will come up for discussion during the week of 13 May. It is expected that action will have been taken on the extension of Selective Service by 10 May, and that the Senate will not be ready for the debate on the extension of OPA. In the week between the debates upon these controversial pieces of legislation, it is proposed to turn to science, giving consideration to the Kilgore-Magnuson bill, the McMahon bill on Atomic Energy, and the Fulbright bill. Already the week of 13 May has been dubbed "Science Week" by the Senators.

To inform the members of the Senate how American scientists feel about S. 1850, Dr. Conant has composed a letter which has been sent to every Senator except those who have sponsored the bill. The letter tersely outlines the reasons why the National Science Foundation should be created, and the reasons are pertinent not only to Congressmen but also to scientists. For this reason the full text of the document is printed herewith:

Dear Senator

It is my understanding that Senate Bill 1850 creating a National Science Foundation is on the Senate Calendar, and I am writing on behalf of the American Association for the Advancement of Science to ask your support of this legislation.

Designed to promote the training of young scientists, to sponsor new fundamental research, to disseminate the results of research widely for the benefit of the public, and to restore national strength in scientific and technological fields, this bill is extremely important legislation, which scientists have endorsed by an overwhelming vote in the American Association for the Advancement of Science Council. The Association, in addition to its own 28,000 members, has 196 affiliated scientific societies with gross memberships in excess of 600,000. These affiliates have representation on the American Association Council which has just voted 228 to 10 in favor of S. 1850.

The Bill is non-partisan. It embodies carefully evolved compromises on such controversial questions as the administrative organization of the Foundation, the treatment of patents, the inclusion of the social sciences, and safeguards for scientific freedom. Not only the scientists, but the members of the Senate committees who have formulated the bill, have found a meeting ground in the sound and solid provisions comprising S. 1850; and these Senators, following consultation with government agencies that will be concerned in its operation, are satisfied that it is practical and will work. More than six months of research, analysis, and conference are embodied in the bill, and I am confident that you can accept it as a well considered piece of legislation which will greatly benefit the Nation.

In view of the importance of S. 1850, I venture to ask your support both in bringing the Bill to a vote and in voting for it, and I will appreciate your assurance that this support will be given.

Very sincerely yours,
JAMES B. CONANT, *President*
Harvard University and
American Association for the
Advancement of Science

Although the sponsors of the bill feel that the proposed legislation is sound and will command considerable respect and support in the upper chamber, they anticipate some opposition from a few of their colleagues. There are some who are opposed to the patent provisions of the bill, but it may be pointed out that S. 1850 contains no new patent legislation, although it does systematize patent policy within governmental bureaus and departments. It is difficult to see what legitimate or logical objection could be raised to systematization. There are others who are opposed to the inclusion of the social sciences but, as Senator Fulbright has aptly said, there is no field in which fundamental research is more urgently needed, and there is none in which greater return to the public welfare can be achieved. Even more serious is a widespread feeling that the creation of one more government agency, calling for an initial appropriation of approximately $40–45,000,000, and an ultimate annual appropriation in excess of $100,000,000, would be a mistake. Such a feeling, if prevalent, ignores the significant tangible and intangible returns which the National Science Foundation will bring to our Nation.

Within the ranks of science most of the opposition for S. 1850 is professionally localized. From the outside the only known organized opposition comes from the National Association of Manufacturers. In the four-page release which the National Association of Manufacturers recently directed against S. 1850, it was not demonstrated that industrialists have an important stake in the creation of a National Science Foundation, and their gratuitous opposition to a carefully considered experiment designed to advance science must be branded as presumptuous. The relationships between science and industry are close and vital, but this fact does not give either group the prerogative to intervene in the affairs of the other. The National Association of Manufacturers has not been noted for its public relations policy, and it seems unfortunate that this organization should now attempt to obstruct legislation that has been painstakingly worked out with the collaboration of eminent scientists who have close ties with industry.

It is unnecessary to stress the fact that the week of 13 May may be an extremely critical period in the history of this proposed legislation. Favorable action in the Senate may make it possible to secure action in the House before the current session of Congress comes to an end. Unfavorable action will mean, at best, a delay of a year in the creation of a National Science Foundation. More ominously, it may mean the death of constructive science legislation.

Association Affairs

AAAS Buys Washington Building Site

Scott Circle Property Assures Convenient Location

On Monday, 29 April, the Association closed with representatives of the owners of four separate parcels of ground, the whole comprising a wedge-shaped site on Scott Circle in Northwest Washington, for a future permanent headquarters building. It will be possible to enter the building from Scott Circle, Massachusetts Avenue, N Street, or Fifteenth Street.

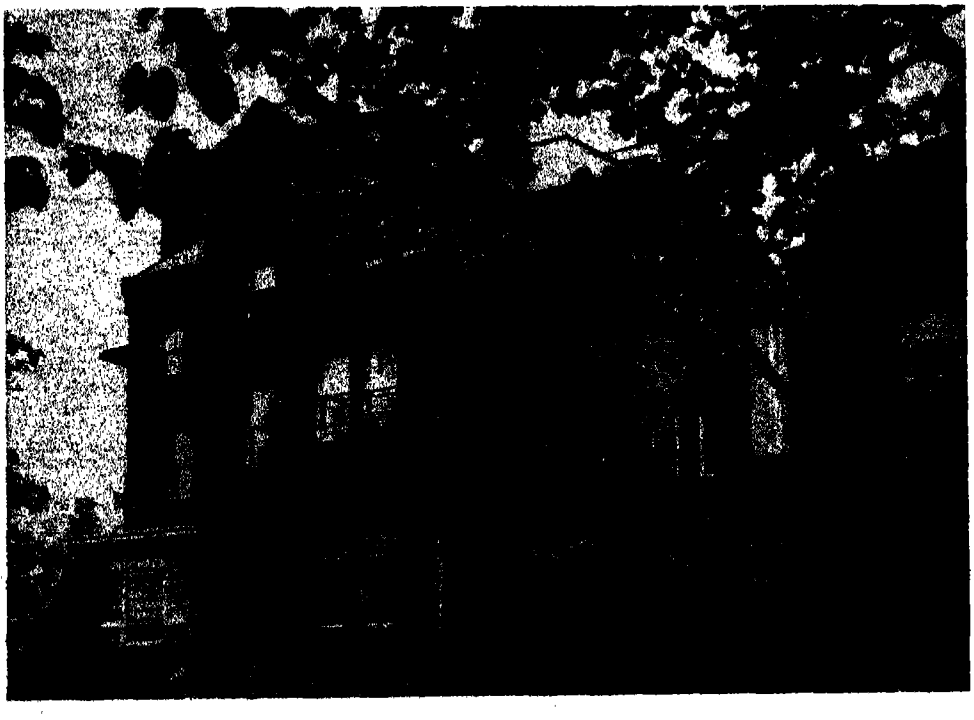
The site was purchased with money collected for the purpose during the fall and winter. At the time of the purchase the building fund amounted to approximately $100,000, all of which, and more, was used for the land.

The location is convenient with respect to the Union Station, the National Airport, principal hotels, and other scientific and learned societies which maintain Washington offices.

The separate parcels comprising the site were each improved with buildings originally constructed as residences, but the largest, 1515 Massachusetts Avenue, has been used for business-office purposes for some years and will be available for Association use by 15 July. The other buildings will temporarily be continued as residence units, the income from which will accrue to the Association.

The principal building, shown in the figure below, contains four usable floors, totaling approximately 5,000 square feet of floor space, an amount sufficient for the immediate needs of the Association. No extensive remodeling is necessary.

It is planned to retain some space in the Smithsonian Institution until well into 1947, or even later, so that current operations will not come to a halt during a moving period.



Photograph by courtesy Science Service

The photograph shows the Massachusetts Avenue entrance to the new home of the Association. It is expected that some of the Washington offices, including the offices of *Science* and the *Scientific Monthly*, will occupy space in this building at 1515 Massachusetts Avenue about 15 July. Ultimately this building will give way to a new nine-story structure designed and built to accommodate the rapidly extending functions of the Association.

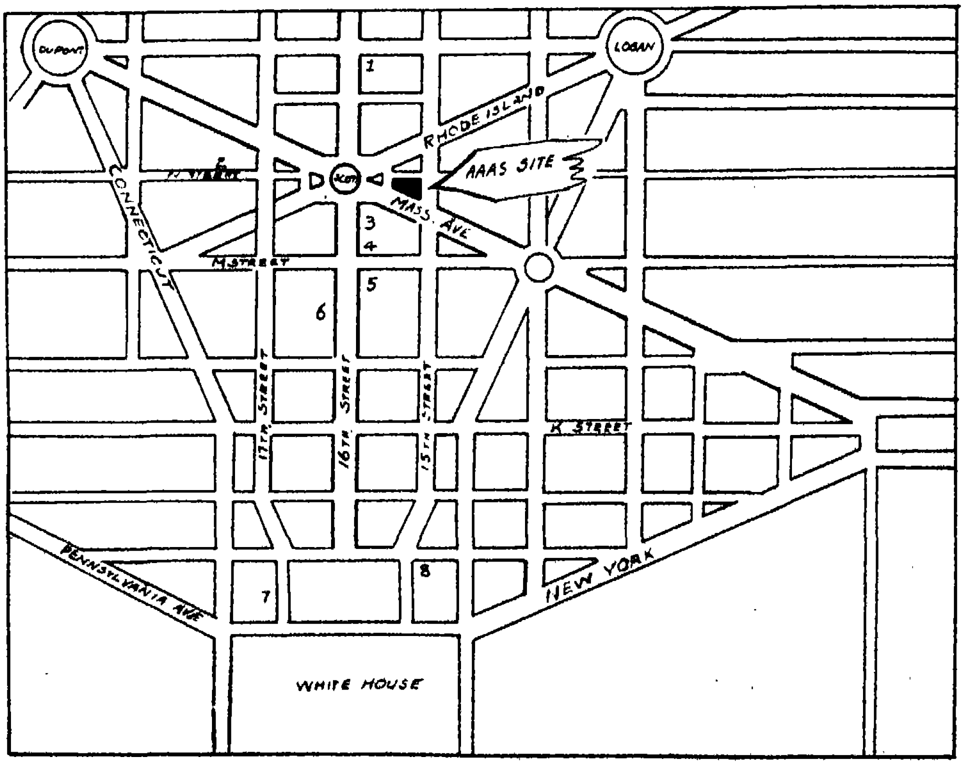
The city zoning area within which the new property falls is restricted to residences or offices, libraries, and laboratories of nonprofit associations and institutions. The area never will become commercial. The plot contains approximately 9,000 square feet of land, 90 per cent or 8,100 square feet of which may be used for building purposes, but the proposed building must not be over nine stories, so that a potential floor area of 72,900 square feet is possible.

The site was chosen by a subcommittee representing the Executive Committee. The subcommittee was appointed by A. J. Carlson, Executive Committee chairman, following extended discussion of the principles involved at St. Louis, and was composed of C. F. Kettering; F. R. Moulton, administrative secretary; Howard A. Meyerhoff, executive secretary; A. N. Richards, vice-president, University of Pennsylvania; Phillip Bard, Johns Hopkins; Warren Magee, counsel; and W. L. Valentine, editor of *Science*. After inspecting this and other property which was available, the subcommittee reported favorably on the Scott Circle plot at a meeting of the Executive Committee on Wednesday, 24 April. The Executive Committee accepted the report, inspected the property, and authorized purchase which was consummated five days later.

It is the consensus of opinion in the Executive Committee that the Association is really under way in providing itself with a permanent home. Now that the location is settled upon, it will be possible to make specific plans for the utilization of the land, and architects can be employed to put the needs of the Association into concrete plans for a functional building.

This rough map shows the location of the newly acquired AAAS property with respect to some well-known Washington landmarks. Scott Circle is on the north and south axis of a reference point which includes the White House, the zero milestone, and the Jefferson Memorial (to the south of the area shown). Vermont Avenue and Connecticut Avenue, extended, intersect at a point in the center of the White House. From the zero milestone, due north through the White House along 16th Street, is exactly 4,500 feet. The property is roughly 200 feet east of the center of Scott Circle.

From the center of Scott Circle, along Massachusetts Avenue, to the boundary of the map is three-quarters of a mile; the Union Station is only one mile further on Massachusetts Avenue. The numbers on the map identify the approximate locations of the following well-known properties: 1, The Carnegie Institution of Washington; 2, Science Service; 3, American Council of Learned Societies; 4, National Education Association; 5, American Chemical Society; 6, Geographical Society of America; 7, Brookings Institutes; 8, Cosmos Club. The Statler Hotel and the Carlton, not included on the map, are at 16th and K Streets, five blocks from Scott Circle.



News and Notes

R. Plato Schwartz, associate professor of orthopedic surgery at the University of Rochester School of Medicine and Dentistry, left by plane on 30 April for England and Germany to study the problem of military footwear as scientific consultant to the U S. Army. He will return in June.

F. R. Moulton was honored by a birthday party given by the staff of the central office at the 2400 Club on the occasion of his 74th birthday, Monday, 29 April. Besides Dr. Moulton the guests of honor included two of his brothers, Harold G. Moulton, president of the Brookings Institutes, and Verne V. Moulton, president of Auto Owners Insurance Company. Also present were Dr. Barbara Moulton, a resident physician at the Suburban Hospital, Bethesda, Mrs. Harold G. Moulton, and Mrs. Verne V. Moulton. Dr. and Mrs. E. J. Stieglitz, close friends, were among the guests. During the evening Dr. Moulton revealed in a humorous vein the steps that led up to the acquisition of the Washington building site on Scott Circle.

Walter N. Ezekiel, recently stationed at the Naval Ordnance Laboratory, Silver Spring, Maryland, and previously plant pathologist at the Texas Agricultural Experiment Station, is now principal mycologist, Bureau of Ordnance, Navy Department, Washington 25, D. C.

Wilfred J. Brogden has been appointed visiting lecturer on psychology at Harvard University for the summer term of 1946. Prof. Brogden will offer a course in the psychology of learning and a seminar on the conditioned reflex.

Melvin H. Knisely, associate professor of anatomy at the University of Chicago, delivered the ninth annual Nobel Pierce Sherwood lectureship at the University of Kansas, Lawrence, on 29 March. His subject was: "Intravascular Agglutination of Blood in Disease."

T. S. Lovering, professor of economic geology, University of Michigan, delivered two lectures under the sponsorship of the William Harvey Emmons Fund to the advanced students of geology at the University of Minnesota on 8 and 10 April.

Preston E. Cloud, Jr., now a member of the U. S. Geological Survey, has been appointed assistant professor of geology at Harvard University. On 1 July he will begin research and instruction in paleontology as successor to Dr. Percy E. Raymond, now emeritus professor of paleontology.

Dr. Madge Thurlow Macklin has joined the genetics group at the Ohio State University as senior research fellow of the National Research Council. She will work on the inheritance of human cancer.

Dr. Clarence W. Clancy, formerly on leave for service with the AAF as an aviation physiologist, has returned to his departmental duties with the rank of assistant professor of biology at the University of Oregon.

Dr. K. A. G. Strand, of the Sproul Observatory, Swarthmore College, has been appointed visiting associate professor at the University of Chicago beginning 1 October. Dr. Strand will be in charge of observational work in positional astronomy at the Yerkes Observatory and also at the McDonald Observatory of the University of Texas. He will be engaged primarily in photographic and visual observations of double stars.

John T. Emlen, now at The Johns Hopkins University, has been appointed associate professor of zoology at the University of Wisconsin. He will join the Wisconsin staff in September.

Laurence H. Snyder, of the Ohio State University, delivered the 21st Annual Herman M. Biggs Memorial Lecture before the New York Academy of Medicine on 4 April on the subject "Medical Genetics and Public Health."

Dr. Harold Macy, a dairy bacteriologist, was appointed associate director of the University of Minnesota Agricultural Experiment Station on 15 March. He first joined the staff in 1919 and in his new position succeeds Dr. Forrest R. Immer, whose death occurred recently.

Dr. John R. Dick, of Wheeling, West Virginia, has been appointed assistant professor of veterinary medicine at Ohio State University.

Dr. Joseph W. Ferrebee has been appointed assistant professor of medicine at the Harvard Medical School and Peter Bent Brigham Hospital where, in addition to his clinical teaching, he will head a program of research in fundamental aspects of the mechanism of hypersensitivity.

Colin G. Fink, professor of electrochemistry at Columbia University, was awarded honorary membership in the Electrochemical Society at the recent Birmingham Congress of the Society. Dr. Fink is a member of the AAAS Council and of the National Research Council, representing electrochemistry.

John R. Murlin has been honored by having the current volume (31) of *The Journal of Nutrition*, which covers the period January–June 1946, dedicated to him. According to his associates, Dr. Murlin, more than any other one person, has been responsible for the establishment of both the journal and its supporting professional society of research workers in the science of nutrition, the American Institute of Nutrition. Dr. Murlin served as the first editor of the journal, but gave up the responsibilities of his office in 1939, when he reached the age of 65 years and thus became an emeritus member of the American Institute of Nutrition.

In 1944, Dr. Murlin reached the age of 70 years and under normal conditions would have retired from his professorship at the University of Rochester. On account of the war and the shortage of personnel, however, he continued active for another year, and definitely retired in June 1945.

George W. Kidder, formerly assistant professor of biology at Brown University, has been appointed associate professor in the Department of Biology at Amherst College. His appointment was effective on 15 April 1946.

Horace G. Richards, associate curator of geology and paleontology at the Academy of Natural Sciences of Philadelphia, has received the "President's Award" from the American Association of Petroleum Geologists for his paper on "Subsurface stratigraphy of the Atlantic coastal plain between New Jersey and Georgia." The award was presented to Dr. Richards at the recent meeting of the Association at Chicago. During May, Dr. Richards will give the Distinguished Lecture Series on this subject before various geological societies in the country.

John D. Kraus, of the Radio Research Laboratory, Harvard University, has been appointed associate professor of electrical engineering at the Ohio State University.

Lyle R. Dawson, head of the Chemistry Department of the University of Kentucky, Lexington, addressed the Memphis Section of the American Chemical Society on 3 May. He said in part:

> The fissioning of atoms is no more astounding than the process of cell division which occurs in plants and animals. Perhaps it is actually much less complicated. The process is understood well enough to be quite easily controlled.
>
> Hence, when we speak of "controlling the atomic bomb," we realize full well that the fundamental problem is the control of the human element—particularly those tendencies which lead to bigotry, greed, selfishness, and the desire for power.

Prof. Emilio Trabucchi, from the Department of Pharmacology of Modena, is continuing his research activities. His laboratory survived the war and is also in need of books and periodicals.

Prof. Rabbeno, former director of the Department of Pharmacology in Genova, victim of racial persecution, is being reintegrated in his official position. He escaped deportation, like many other Jews in Italy, due to the generous help which the Italian people gave to those persecuted.—*Nicholas Ercoli* (Warner Institute for Therapeutic Research).

Announcements

At the Seventh Annual Meeting of the Association of Southeastern Biologists in Columbia, South Carolina, 19–20 April, legislation concerning the creation of a National Science Foundation was discussed and the following resolution adopted:

> WHEREAS, The members of the Association of Southeastern Biologists subscribe fully to the principle that "a full development of the nation's scientific and technical resources is essential for the national defense, national prosperity, and the national health and welfare"; and
>
> WHEREAS, The application of this principle is of unusual importance to the South; therefore,
>
> RESOLVED, That this Association, through its Secretary, urge all Congressmen representing this region to give their full support to the immediate passage of legislation providing for a National Science Foundation with adequate financial support.
>
> RESOLVED, That the Association go on record as giving its general approval to the bill, S. 1850, now before Congress and urge our Congressmen to give it their support.

The Department of State is seeking the counsel of leaders in the fields covered by that Organization in order to enlist the widest possible discussion of the future program of UNESCO. In the field of natural science and technology, steps are under way to appoint a group of consultants. It is hoped that this group will be able to enlist the widest possible cooperation among the groups of scientists in the United States and among individuals and organizations engaged in related activities in the fields of scientific research and technological developments.

The group will advise the State Department in providing means for informing all interested scientific groups and individuals in the United States of the plans and programs of UNESCO and in securing ideas and suggestions from groups and individuals regarding the functions and activities of UNESCO.

The newly appointed group of consultants includes: Detlev Bronk, Howard Meyerhoff, W. Albert Noyes, Harlow Shapley, and Merle Tuve.

A new degree, Doctor of Forestry, will be offered at Yale beginning in the fall of 1946, according to Dean George A. Garratt, Yale School of Forestry. By this action, Yale will become the second university in the Nation to offer work leading to this degree. At the present time, Duke University is the only institution in the country which grants this degree.

Standards of performance for the newly-established degree will be essentially the same as for the Ph.D. The minimum requirements will be six full terms of graduate study and research, although some students will require additional time. At least two consecutive terms of resident study must be carried on at Yale. All students must possess a reading knowledge of French and German before they are permitted to undertake their second year of graduate study.

The D. For. degree is not intended to compete with, or serve as a substitute for, the Ph.D., since it is expected that the student will continue to work in the Graduate School for the Ph.D. degree when his interests lie in such fields as forest economics, forest soils, forest ecology, and other subjects allied to the fundamental sciences.

The Yale School of Forestry, which is the oldest established forestry school in the United States with an unbroken history, currently has an enrollment of 75 students, the largest number registered since 1911.

The National Registry of Rare Chemicals, Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois, has submitted their new needs in the following list of chemicals: cryogenine; 1,3-dinitrosoacetone; thymoform; 3,5,8,10-tetramethoxy pyrene; pyrene carboxylic acid methyl ester; daphnetin; 1,8-diamino naphthalene; cis-stilbene; isocrotonic acid; thianaphthalene; 1,3-dihydroxy indane; 5,5′-dimethyl thioindigo; dihydroxy thiophenes; dihydroxy thiapyrans; acetylene urea; cerotic acid; melissic acid; p-aminophenyl selenoic acid; hydroxy aspartic acid; elaidyl alcohol; β,β′-dithiocyano diethyl ether. Please communicate regarding these directly with the Registry at the address given above.

A new Division of Psychological Services has been established within the Department of Psychology at the University of Pittsburgh. Wayne Dennis, head of the Psychology Department, has announced the appointment of William R. Grove as director of the new Division. To make possible the additional work of the Division, as well as to provide for the instruction of the increased number of students in psychology, four men have been added to the teaching and service staffs: Victor C. Raimy, Roger W. Russell, John Valentine, and Ralph E. Jenson. The Psychology Department now has a staff of 20 psychologists.

The "tropical house," a source of mystery to all who visited the University of Pennsylvania's botanical garden during the war, was built in one of the greenhouses there and is approximately 5 feet wide and 10 feet long. Constructed of concrete blocks, it is equipped with automatic controls which provide a daily cycle of temperature and relative humidity similar to that encountered in the rain forests of some of the Pacific areas.

According to Wesley G. Hutchinson, associate professor of botany at Pennsylvania in charge of the project, it was begun in the summer of 1942 under the Committee on Optical Instruments but was transferred later to the Tropical Deterioration Administration Committee.

Upon completion of the house, the floor was covered with a thick layer of tropical leaves from the greenhouses, and these were heavily inoculated with various types of tropical fungi and mites, which are known to spread the fungi.

Although it was impossible to reproduce in a house of this type the complex biological balance of a tropical rain forest, subsequent comparison of the rate of deterioration of materials in the house with that of the same materials exposed in the Panama jungle showed remarkable similarity.

The house, it was pointed out, was the first tropical chamber of its type to be employed in studies of tropical deterioration, although several others on the same general plan were constructed later at service laboratories.

In addition to using the "tropical house" on the Pennsylvania campus, Dr. Hutchinson made several trips to the Canal Zone and the Republic of Panama in 1943 and 1944 to study deterioration at first hand. As a result of these trips it was decided to establish a semipermanent laboratory in the tropics to extend the work being done at the University and to provide a place for testing materiel and methods of deterioration prevention under actual jungle conditions. The laboratory was set up on Barro Colorado Island in the Panama Canal Zone in the summer of 1944. Barro Colorado, which covers about six square miles, is an island in Gatun Lake, set aside as a biological preserve by Act of Congress.

At this jungle laboratory a program of testing and research was carried on, from June 1944 until the termination of the OSRD contract in October 1945, by Spencer H. Davis, Jr., and J. A. Jump, two former graduate students from the University, who were alternately in charge of the work on the island under Dr. Hutchinson's direction.

In addition to the testing of more than 14,000 individual items under jungle conditions for the armed forces, research there was closely correlated with problems under investigation at the University.

Development of a method to prevent the fouling of optical instruments by fungus growth is regarded by Dr. Hutchinson as probably the most important contribution made by the scientists on the project for the duration of the OSRD contract.

The problem was finally solved by the use of a small capsule containing Cresatin (meta cresyl acetate) in ethyl cellulose. This capsule was fastened in the instrument, out of the path of the light rays, and the fungicide volatilized within the instrument sufficiently to produce an atmosphere lethal to fungi. Instruments treated in this manner and stored in jungle positions were still clean after two years exposure, although untreated instruments may become fouled within three weeks.

A dental specialists unit to conduct postgraduate refresher courses in Holland has been organized by the School of Dentistry of the University of Pennsylvania, it has been announced by George W. McClelland, president of the University.

Designed to aid in restoring dental practice in Holland to its prewar level, the courses will be given in Amsterdam this summer for 200 Dutch dentists and 100 from other European countries, all of whom were prevented by the war from keeping abreast of modern developments in dentistry.

Instruction, beginning on 15 July and continuing for one month, will be in the fields of dental therapeutics, roentgenology, denture service, oral medicine, and diagnosis. Each course will be of two weeks duration and will be repeated once.

Character and Personality, the psychological quarterly edited by Karl Zener, of Duke University, has changed its title to *Journal of Personality.* The primary purpose of the journal is to serve as a coordinating medium of publication for original scientific investigations within all the major research areas concerned with personality. These would include, among others, studies of personality structure, its biological aspects, its expression in behavior dynamics, and its development and functioning in varied cultural contexts. A more complete statement of the editorial reorientation appears in the September issue, which first carried the new title. Emphasis will be placed on experimental and various other empirical types of research within the field, but relevant theoretical and methodological contributions will be included.

The Gans Fund has just made awards for scientific research to the following, it has been announced by Dr. B. R. Weimer, of Bethany College, West Virginia: William Montagna, Long Island College of Medicine; Esther L. McCandless, Cornell University; Helen Golden and Burton Kallman, Bethany College. This fund of $50,000 was established in 1939 by Wickcliffe Campbell Gans to be used to assist undergraduates and graduates of the College in scientific research.

The Central Examining Board of the Naval Air Training Command, located at Pensacola, Florida, will continue its standardized testing program for naval aviation training. The key examiner posts, held by military personnel during the war, have been transferred to Civil Service. Lawrence Andrus, formerly assistant professor at the University of Chicago, has been appointed senior test development examiner and has as his assistant Raymond F. Monsalvatge, Jr. The Navigation representative on the board is E. J. Koestner, who previously filled this position in a military capacity.

The School of Dental and Oral Surgery of the Faculty of Medicine, Columbia University, announces the establishment of a limited number of fellowships for graduates of dental schools. These fellowships will offer opportunity for study in the following basic science departments of the University: anatomy, bacteriology, biochemistry, pathology, pharmacology, and physiology. For further information regarding qualifications and stipends, address the Dean of the Faculty of Medicine, Columbia University, 630 West 168th Street, New York City.

Meetings

The British Association has found it impossible to arrange this year an annual meeting on the lines of the prewar meetings in provincial cities. A one-day meeting will therefore be held on 20 July in London. The British Medical Association has granted the use of its hall for this occasion. The presidential address will be delivered by Sir Richard Gregory. There will be no sectional meetings. Opportunity will be taken to receive delegates attending the Empire Scientific Conference organized by the Royal Society, and the Commonwealth Scientific Official Conference, at a luncheon on 20 July and at the subsequent meeting, and also, it is hoped, at a Sunday afternoon reception at Down House, the home of Charles Darwin. It is also hoped to receive some of the foreign delegates who are expected to be in England at that time. It is intended to resume normal meetings in subsequent years, and an invitation has been accepted for the meeting in 1947 to be held in Dundee, where the meeting in 1939 was cut short by the imminence of war. An invitation from Brighton for 1948 has also been accepted.—*Nature, London.*

The 46th General Meeting of the Society of American Bacteriologists will open at 10:00 A.M. on Tuesday, 21 May, and will close at 5:00 P.M. on Friday, 24 May. All sessions will be held in the Book-Cadillac Hotel in Detroit, Michigan. Features of the meeting include the following addresses: "Immunologic Aspects of Protein Metabolism": Paul R. Cannon, University of Chicago; "Some Applications of Physical Methods of Bacteriology": Ralph W. G. Wyckoff, National Institute of Health. Round-table and symposia sessions have been organized for the following topics: (1) Early History of Bacteriology in Michigan, (2) A Discussion of Influenza, (3) Streptomycin, (4) Bacterial Taxonomy, (5) Microbiological Problems in the Processing and Spoilage of Foods, (6) Air Disinfection, and (7) Immunological and Physiological Activity of Factors Derived From Pathogens. The Committee on Teaching will sponsor a panel discussion on the general topic of "The Teaching of Bacteriology at the Graduate and Professional Levels." The president of the Society, James Craigie, of the University of Toronto, will deliver the banquet address: "The Significance and Applications of Bacteriophage in Bacteriological and Virus Research." The $1,000 award of the Eli Lilly Company will be presented to a young bacteriologist in recognition of research accomplishments.

Approximately 140 research reports from members of the Society will include discussions of the following topics: morphology and cytology of bacteria, disinfection and chemotherapy, viruses, antibiotic production and induced resistance of bacteria to antibiotic agents, sanitary bacteriology, physiology and metabolism of bacteria, and industrial processes. Post-convention trips have been arranged to include visits to the University of Michigan, Michigan State College, and the Bureau of Laboratories of the Michigan Department of Health. During the convention various alumni luncheons and other meetings have been scheduled.

Persons who are interested in bacteriology, in addition to members of the Society, are cordially invited to attend the scientific sessions and to visit the exhibits. Programs of the meeting may be obtained from the secretary-treasurer of the Society, Dr. L. S. Parr, George Washington University, 1335 H Street, N.W., Washington 5, D. C., or from the chairman of the Program Committee, Dr. L. S. McClung, Indiana University, 420 Kirkwood Hall, Bloomington, Indiana.

The Cold Spring Harbor Symposium on Quantitative Biology will be held 2–12 July and will deal with the topic, "Heredity and Variation in Microorganisms." Among the 26 participants in the program will be several from Europe. Attendance will be limited to 80. For program and information, address the Biological Laboratory, Cold Spring Harbor, New York.

The Eastern Section of the Seismological Society of America is holding its annual meeting at the Institute of Geophysical Technology of St. Louis University, St. Louis, Missouri, 14 through 16 June. Following the presentation of technical papers, a special symposium is proposed on the discussion of the problems involved in the establishment of new seismograph stations.

Japanese Scientific Men

News of numerous scientific men in Japan and some of their publications are now reaching this country through U. S. Army and Navy officers and scientists who are going on missions to that country. More information has been received from the GHQ Natural Resources Section, of which Lt. Col. Hubert G. Schenck is the chief, than from any other source.

On 16 December 1945 there was a meeting of Japanese and American geologists at the Geological Institute, University of Tokyo. Of the American geologists, H. G. Schenck, T. A. Hendricks, Edward Sampson, H. S. Ladd, and F. C. Whitmore, Jr., contributed papers.

Thirty-five Japanese were present. Their names, with their specialties, are as follows: K. Asano (Foraminifera), B. Bessho (geology), Shoshiro Hanzawa (paleontology), Wataru Hashimoto (stratigraphy), S. Hori (economic geology), H. Huzimoto (geology and paleontology), H. Imai (economic geology), S. Iwao (petrology), Takeo Kato (economic geology), S. Kinshi (geography), Teiichi Kobayashi (historical geology, tectonics, stratigraphy, and paleontology), Jiro Makiyama (geology), Kosaburo Makino (mineralogy), Ichiji Mori (mining geology), Ryohei Morimoto (petrology), T. Nisiwaki (economic geology), Kei-iti Ohmori (petrology and mineralogy), T. Ohinomikado (Foraminifera), Y. Otuka (paleontology and stratigraphy), K. Sakakura (coal geology), K. Sawamura (petrology), S. Sekiguchi (interpreter), Ryuichi Sonobe (geology), T. Sudo (mineralogy), R. Sugiyama (petrology), Hisashi Suzuki (anthropology), Fumio Tada (geography), Fuyuji Takai (vertebrate paleontology), Jun-ichi Takahashi (economic geology), Seitaro Tsuboi (petrology), T. Tsujimura (physical geography and topography), Kunio Uwatoko (petroleum geology), T. Watanabe (economic geology), Hisakatsu Yabe (paleontology), and Shinji Yamane (geology).

Dr. H. Hattori, the director of the Imperial Biological Laboratory, on the Imperial Palace Grounds, and also director of the Tokugawa Biological Institute, both in Tokyo, is well and is still carrying on his scientific researches.

Prof. M. Matsuyama and Dr. N. Kumagai, of the University of Kyoto, are well and are continuing their gravimetric studies. Marquis Yoschichika Tokugawa, the founder of the Tokugawa Biological Institute which is devoted to botanical research, is well and active. His name has been in the papers with reference to a proposal made by him for curbing the political activities of the Emperor—a matter taken care of in the announced new constitution for Japan. —*T. Wayland Vaughan* (Washington, D. C.).

Letters to the Editor

The Serodiagnosis of Amebiasis

Early studies on the serodiagnosis of amebiasis yielded inconclusive results. It was not until the work of C. F. Craig, demonstrating the occurrence of complement-fixing antibodies in the serum of subjects infected with *E. histolytica*, that the development of a satisfactory serologic procedure appeared possible (*Amer. J. trop. Med.*, 1927, 7, 225; 1928, 8, 29; 1929, 9, 277). However, the test possessed certain limitations, the major difficulty being experienced in the preparation of a uniformly reactive antigen. Recognizing this problem, C. W. Rees and his associates developed a technic for cultivating the specific organism in the presence of single bacterial symbionts; saline extracts of the cultures appeared more constant in antigenic activity, and a complement-fixation technic employing the new antigen was reported as yielding encouraging results in a preliminary study (*Amer. J. trop. Med.*, 1942, 22, 581).

Studies undertaken at this laboratory have been designed to determine the principles governing the optimal adjustment of reagents and conditions in complement-fixation tests. As a result, a quantitatively standardized technic based upon the use of the 50-per cent unit of complement has been developed for use in studies on the serodiagnosis of amebiasis. An experimental antigen prepared according to a modification of Rees's method has been supplied by the Hynson, Westcott, and Dunning Company of Baltimore, Maryland. The employment of a constant source of preserved sheep's blood (S. C. Bukantz and the writers, *J. lab. clin. Med.*, in press), and the adaptation of the spectrophotometer, with simple graphic methods, to the standardization of the hemolytic reaction (*J. Immunol.*, in press), have contributed accuracy and facility to the technic. A total volume of 1.0 ml. is used in tests, 0.2 ml. being allotted to each of the reagents. A 1: 2 dilution of serum in salt solution is tested, alone and with antigen, in the presence of three 50-per cent units of complement. Four hours at 3–6° C. are allowed for fixation, and 30 minutes in the water bath at 37° C. for hemolysis. The foregoing conditions are advocated at present in order to avoid such nonspecific reactions as appear with the use of more dilute serum and extended periods of fixation.

Present indications are that the test provides a valuable laboratory adjunct in the diagnosis of amebiasis, particularly in cases in which failure to isolate the specific pathogen prevents the establishment of a definitive diagnosis. The details of the technic and the evaluation of its sensitivity and specificity will be the subject of a later communication.

In this work, the writers have had the technical assistance of Rebecca Goodman and Helen Conway.

John F. Kent and Charles R. Rein
Division of Serology, Army Medical School
Washington, D. C.

Biology in College and High School

The letter by Charles A. Gramet (*Science*, 1946, 103, 149) includes many provocative points, several of which I wanted to discuss. Space limits me to essentially one aspect.

In high school, as contrasted with chemistry and physics, biology holds an unfavorable position in local schools, being a nonrequired course, lacking laboratory periods, and being given to sophomores, about 15 years old. Also, as the course has become more "civic biology," a good trend for the high schoolers, it has become less a college preparatory course and still less an equivalent of a college biology course.

College offers a contrast. I do not refer merely to the plan of a year of college laboratory general biology. Large universities generally have separate botany and zoology departments. Each has an extensive year introductory course. Also, many medium-sized universities and colleges have to equal this setup. We give a year course in general zoology (8 credits) and a general botany course of similar length. Our majors must take both. Few other students take them.

My zoology has to be a thorough course with adequate systematic zoology included, as it must prepare for any or all of the advanced, junior and senior zoological courses, each usually a one-semester course, each crowded, without time for review of "general zoology," and each of which must essentially advance a student up to graduate rank. The botanist has the same situation to meet. Of course, I believe that our 16 credits of university zoology and botany, given usually to sophomores, four or more years older than high school sophomores, is vastly more than any high school biology course.

WALTER C. KRAATZ

Biology Department, University of Akron, Akron, Ohio

Gift Packages Direct to Scientists in Europe

An active interest has been shown by Americans in sending parcels directly to families of the universities and scientific laboratories in the countries formerly occupied by the Axis. A check of the records kept by the secretary of the Committee listed below shows that 485 families have been referred since November to donors from coast to coast. An estimate of the parcels already sent indicates that they number about 650 (three tons). In Holland alone some 300 families have been assigned to American families, and an estimated 450 to 500 parcels have been sent. A number of interesting and appreciative letters acknowledging receipt of the earlier parcels have been received.

The Committee has in its files 125 families in six countries (Holland, France, Belgium, Czechoslovakia, Norway, and Greece) that have not yet been assigned to anyone and about 150 others to whom many additional articles should be sent. The need for clothes (especially warm ones and shoes), bedding, notions, and food is still very great and will probably remain so through next winter.

If you can send a parcel to a professional colleague, you may obtain a name from the secretary of this Committee. The majority of the families now listed with the Committee are from Holland. Direct correspondence with these Dutch families has resulted in specific information regarding the needs of each family and the sizes of persons in the family. The information on hand for other countries is, in general, not yet so complete. In many cases it may not be possible to send all of the items mentioned by the family assigned to you, but it should be remembered that partial fulfillment of these needs is much better than no package at all. Although the things you have to send may not fit exactly the family assigned to you, our experience shows that these people are not reluctant to help their friends or neighbors by passing on any articles they themselves cannot use.

Committee members: Langhorne H. Brickwedde, Louise McD. Browne, Emilie H. Condon, Lola S. Deming, Alma R. Hamer, Mildred R. Masi, Grace H. Ruark, and Grace H. Smith.

GRACE H. SMITH, *Secretary*

National Bureau of Standards, Washington, D. C.

Histochemical Localization of Adenosinetriphosphatase

In *Science* (1946, 103, 144), Moog and Steinbach pointed out certain limitations of the method presented in a paper by Glick and Fischer (*Science*, 1945, 102, 429–430), entitled "The histochemical localization of adenosinetriphosphatase in plant and animal tissues." Since the method depends on the visualization of phosphate liberated enzymatically from adenosinetriphosphate (ATP), it will, of course, demonstrate the presence of any phosphatase that can act on this substrate and, in addition, any phosphatase, if also present, that can act on the products of the scission. The specificity of these enzymes, and hence the best nomenclature, has not been completely clarified as yet. However, the impression should not be given that the method in question does not have its field of application.

As Moog and Steinbach pointed out, the method will detect ATPase separate from any other phosphatase that can act on ATP when they have different cellular distributions, or when only, or predominately, the ATPase is present. The latter is the case in certain instances. For example, Glick and C. C. Lushbaugh (unpublished observations from the University of Chicago Toxicity Laboratory and Department of Pathology) found that the muscle and ganglia of the cockroach (*Periplaneta americana*) gave a positive reaction in the histochemical test with ATP and a negative reaction with glycerophosphate under the same conditions. K. P. DuBois and V. R. Potter (*J. biol. Chem.*, 1943, 150, 185) observed that rat liver contained appreciable ATPase but had a negligible action on glycerophosphate; this work was carried out at pH 7.4, however. It might be possible to increase the field of usefulness of the method by exploiting differences in properties between ATPase and phosphomonoesterase, such as the difference in activation of the enzymes given by calcium and magnesium (DuBois and Potter).

Moog and Steinbach also emphasized the lability of ATPase in some tissues. Naturally, if the ATPase in a given tissue cannot stand the rigors involved in the preparation of paraffin sections, it would be necessary to use frozen sections and even perhaps frozen sections of unfixed tissue. That ATPase may be present in paraffin sections was indicated by the positive results obtained with cockroach tissues (Glick and Lushbaugh). The length of time required to develop a positive reaction is not critical, however, as it is well known that considerable enzyme losses can occur during histological preparation. This does not impair the validity of the qualitative histochemical test, since loss of enzyme may be compensated by employing longer digestion periods.

DAVID GLICK

Russell-Miller Milling Company, Minneapolis

Sources of Future Scientists

This letter is stimulated by the letter on the above subject by Clarence J. Gamble, M.D. (*Science*, 1946, 103, 457).

While undoubtedly it would be desirable for future scientists to be recruited as largely as possible from the descendants of other scientists, I do not think that it can be shown at any time in the history of civilization that scientists have been recruited chiefly from such stock. It is even true that in other fields of activity they usually have not left families containing nearly as many children as those from the population to which their fathers belonged. Is it not generally true that, in any population, those who have devoted a major portion of their time during youth to acquiring special knowledge or skill in any line have had smaller families than those who have devoted less of their time in special preparation?

At the present time if a young man devotes his energies exclusively to preparation for future work until he has acquired a Doctor's degree from some institution of learning, he is not very likely to have reached that stage earlier than 25 years of age, and if he has been obliged to support himself or any others during that period, he cannot have become a specialist of note until a considerably greater age has been reached. This necessarily means that people who devote their time to preparation are not able to assume the responsibility of raising families of children. If such a man marries a woman approximately his own age, it is not at all likely that they will raise more than two or at most three children to maturity, and if any children are born to them who do not survive, the percentage must necessarily be somewhere about what is recorded in the report of Dr. Bush.

Obviously it is because the population at large, including those individuals who do not devote the major portion of their youth to special preparation, is able because of economic conditions to raise larger numbers of children to maturity, and to give them the proper heredity factors to enable some to become scientists and to provide the means for supporting them during the educational period, that the number of trained scientific people not only has been maintained but has been increased very greatly during the memory of the older persons now living. Admittedly, there are disadvantages to the postponement of the assumption of family duties which not only reduce the number of people able to acquire special training but also cause many who would like to acquire proficiency as scientific workers to fall by the wayside. It does not seem possible to recruit research workers chiefly from the descendants of other scientific research workers unless the means of support during the educational period is subsidized to such an extent as to permit students to assume family obligations of their own choosing. It is doubtful whether such a course would advance science materially, and it is not at all likely to be adopted by democratic communities.

WM. MAYO VENABLE

Blaw-Knox Company, Pittsburgh

Anent "Blood Relationship"

The struggle to shape a proper terminology for use in social science is unending, and the difficulties to be surmounted rear greater obstacles than those confronting the physical scientist. Creation of a new terminology for a newly discovered phenomenon is a relatively easy matter for the physical scientist, who is penetrating new fields where no preconceived terminology has run ahead of him. He creates neologisms, usually from Latin or Greek roots, and more often than not with linguistically fantastic results. By those means he shapes a semantic tool that has a clear and sharp meaning for himself and his professional colleagues, and he little cares how it tortures the tongue of the layman or whether it has meaning to the uninitiate. Happily for the physical scientist, this merely increases his prestige and further awes the layman.

It is otherwise in the lot of the social scientist. His terminological struggles result from the attempt to bring clarity and precision into the language of human relationships—a body of phenomena with which men have been familiar for quite some period of time, if not scientifically informed thereon. Therefore, the layman looks with suspicion and sometimes with hostility toward the social scientist, who uses new terms to deal with what he, the layman, thinks are old and familiar facts. There must be something subversive in a movement that cloaks the "commonplace" in ununderstandable language. In this the layman is right, but not in the way he thinks he is. The purpose of the social scientist is to destroy the inaccuracies of thought which underlie inadequate popular conceptions in the field of social relations.

When the social scientist introduces a new term for an old, familiar, popular label, he does so because the popular term carries such a freight of error and cluttering emotional baggage that it is beyond easy salvage and should best be scuttled. "The meaning of a word lies in the action it produces."

During the recent war the American Red Cross felt it was necessary to segregate negro blood from white in "blood bank" collections and the processing of plasma. This was done, even though the Red Cross was itself aware of the fact that racial traits are carried in the germ plasm and not in the blood. It felt compelled to do so because of the popular belief that hereditary traits are "in the blood." This action of the Red Cross, as we all know, involved it in a tempest of controversy, aligned it with a false and undemocratic position, and created additional work in the extra handling and classification of negro blood and plasma. Fortunately, when it came to saving lives through the use of the plasma, the Army medical corpsmen (or at least some units of them in some areas of action) ignored the racial classifications which the Red Cross had so painstakingly maintained. They paid attention only to the blood-type classifications, thus limiting their selectivity to the needs of scientific fact and properly ignoring the consequences of popular error.

We scientists are in no position to criticize the action of the Red Cross, since we have consistently contributed to popular misconception and are continuing to do so at this very moment.

Like any thoughtless person, we speak of "blood relationship." Anthropologists, of all scientists, are most guilty! In all our discussions of kinship (a subject of consuming interest to anthropologists) we regularly use the term "blood relationship group." The terms "consanguine family," "consanguinity," "consanguine relatives," are all in constant use along with the synonym, "blood relatives." It is not necessary to cite cases. One can pick up any current book or monograph in

Quality—Based on Standards and Craftsmanship

A Diamond *and* the Rough

Optical lenses and prisms formerly had to be separately and accurately mounted in pitch or plaster of Paris for rough and fine grinding and polishing. Today, more and more of these Bausch & Lomb optical elements are diamond milled before polishing. Optical parts are quickly and accurately set up in special precision jigs and speedily surfaced with diamonds on huge precision milling machines. Thus, today, Bausch & Lomb optical elements are fabricated with better control of dimensions . . . faster. Bausch & Lomb Optical Co., 642-5 St. Paul St., Rochester 2, N. Y.

BAUSCH & LOMB

ESTABLISHED 1853

ethnology, or any issue of *The American Anthropologist*, and he is likely to find sufficient instances without painstaking research.

But a moment's reflection shows us how ridiculous and false this terminology is. The clan, for instance, is not founded on any blood tie, nor is any other relationship of family or kin. The relationship may be genuine or fictive, but it rests on a *genetic* principle and nothing else.

The error is even more agregious in physical anthropology when we commonly speak of racial ancestry in terms of blood. It is not unusual, for example, to hear a contemporary anthropologist say that the composite Polynesian race is predominantly Caucasian with a definite Mongolian admixture and a minority element of Negro *blood*. We still speak of half-blood and full-blood Indians.

The error of the anthropologist is shared by his fellow scientists. We unthinkingly carry and perpetuate the timeworn popular fallacy of hereditary continuity through blood. *In the interests of scientific accuracy it is incumbent upon us to stop it.* The imprint of accurate word usage based upon scientific fact must be stamped upon the lexicon of all men by scientists. It is our responsibility not to permit ourselves to be bound by popular word usage based on age-old error, especially when the error serves to generate and perpetuate untold mischief in the affairs of men.

A simple correction can easily be made. For "blood relationship" and "consanguine" substitute "genetic relationship" and "genetic group." For Negro, Caucasian, and Mongolian "blood" substitute "ancestry" or "hereditary of genetic component" unless it *is* blood you are talking about and not racial heredity.

E. Adamson Hoebel
New York University, Washington Square, New York

Book Reviews

Animal cytology and evolution. **M. J. D. White. London: Cambridge Univ. Press, 1945. Pp. viii + 375. (Illustrated.) $7.50.**

This timely and, in many respects, excellent review of the present status of chromosome morphology in relation to genetics hides its subject nature under a misleading title. The author may have intended originally to write a general cytology text; but he narrows the scope of the book in the Introduction, announcing that "by cytology we mean nuclear cytology, since the evolution of cytoplasmic constituents of the cell is an entirely different subject." In fact, even the term nuclear cytology seems too inclusive, considering that the book deals almost entirely with the chromosomes as the carriers of heredity. The comparative lack of purely cytological interest is reflected in the illustrations of the book, which consist of diagrams and simple line drawings.

The author makes a deliberate effort to relate his material with "neo-Darwinian" views, but in many instances, these attempts are unconvincing. By excluding from discussion all protozoans, plants, and lower organismic forms, the largest source of material which might serve as a basis for phylogenetic speculations remains unused. Consequently, the chapter on "The Evolution of Meiosis and the Chromosome Cycle" does not deal with the origin but merely with some modifications of meiosis, mostly as observed in aberrant insect groups. One may justly apply to this and other chapters of the book the commentary which the author attaches to his review of Goldschmidt's Lymantria work: "Its significance from the evolutionary point of view is, however, by no means clear."

The chapter on "The Evolution of the Sex-determining Mechanism" probably comes closest to the proclaimed aim of the book. The obvious fact that several times within the animal kingdom the change from hermaphroditism to gonochorism is followed by an evolution of sex chromosome mechanisms provides a tempting field for theory and speculation. White follows traditional ways in suggesting that sex-determining mechanisms evolve from monogenic differences (at a single chromosome locus), expand through the acquisition of differential regions, and finally become visible under the microscope in the shapes of X and Y chromosomes. He offers an excellent discussion of the relationships between pairing segments and differential segments of the sex chromosomes and their bearing on chiasma formation, crossing-over frequency, and reductional or equational distribution of the sex-chromatin in the first meiotic division. The scarcity or absence of sex-linked mutants in many of the more advanced-type sex chromosomes is connected interestingly with the progress of heteropycnosis. Gradually, the chromosomes seem to lose all original genetic functions except for their role in sex determination. The concluding paragraphs of the book contain the surprising statement that "monogenic sex-determining mechanisms which we observe at the present day, were almost certainly evolved as reversions. . . ." Accordingly, amphibians and teleosts should no longer be considered as links between the primitive hermaphrodite and the advanced sex chromosome types. But such a conclusion receives little support from recent investigations which reveal that, among lower vertebrates, rudimentary hermaphroditism is a relatively frequent occurrence and genetical sex determination is usually in a very labile condition. Furthermore, comparative chromosome studies furnish no indication that, once present, well-developed sex chromosomes were "subsequently lost."

The book serves as a comprehensive guide to the chromosome literature bearing on genetical matters. Entire chapters are devoted to such fundamental subjects as structure of mitotic chromosomes, salivary-gland chromosomes, structural rearrangements and meiosis; others bear on special problems connected with parthenogenesis, male haploidy, and hybrid sterility. The always interesting subject matter is presented in stimulating and easily readable form. In a second printing, some minor errors and inconsistencies should be eliminated.

EMIL WITSCHI

State University of Iowa

Modern plastics. Harry Barron. New York: Wiley, London: Chapman and Hall, 1945. Pp. xv + 680. (Illustrated.) $7.50.

This book, as the author notes in his Preface, has been written for the reader with a modest scientific or engineering background who wishes to obtain an over-all view of the plastic industry. In line with this thought, the book covers all the well-known basic plastics, emphasizing their requisite raw materials, manufacture, processing, and applications. The nine chapters on phenolic plastics cover the phenol formaldehydes, the urea formaldehydes, and the melamine formaldehydes. Special emphasis is placed on the methods of polymerizing and details of molding, casting, and laminating. The five chapters on cellulose plastics are concerned with cellulose nitrate, cellulose acetate, and ethyl cellulose. Of particular interest is the description of the injection molding process. The vinyl resins are well covered, with much attention being given to applications. Brief but excellent chapters on plasticizers and the extrusion process are included. Polyamide plastics, alkyd plastics, and casein plastics are each discussed. High-frequency heating methods, analytical tests, and physical tests are briefly considered.

While the book has not been written for the specialist in plastics polymerization, there are several very good descriptions of the polymerization process both for thermoplastic and thermosetting materials. The author succeeds very well in presenting an over-all picture of plastics chemistry and plastics technology. Although the author is an Englishman, most of the references are to American concerns and literature. However, enough of Germany's and England's contributions are present to give the book a cosmopolitan flavor.

The author makes no pretense of including any up-to-the-minute developments, and such topics as allyl plastics and silica plastics are absent. The newer developments in alkyds and low-pressure laminating are not treated adequately in the light of present knowledge. For American readers, the author's dependence on British testing procedures is unfortunate.

All in all, however, the book can be well recommended as covering the entire field in an adequate manner.

MAURICE E. MARKS

Research Laboratory, Pittsburgh Plate Glass Company

outstanding texts

hoeber book news

Barnard and Robb-Smith's

KETTLE'S PATHOLOGY OF TUMORS

THIS FAMOUS MANUAL of tumor pathology brought up-to-date in a third edition which includes the great recent advances in the field of tumor histology. It rests firmly upon Kettle's statement that "all cancer research must ultimately rest on a histological basis, and it is of the greatest importance to correlate with human pathology the results of experimental research."

326 pages *191 illus.* *$5.50*

Second Edition
Ready Soon! *Everett's*

MEDICAL BIOCHEMISTRY

FUNDAMENTALS of biochemistry are here correlated with medical principles in a successful modern text.

New subjects include adaptive enzymes, amino acid therapy, antibiotic substances, cephalic fractions, cirrhosis, dicumarol, the Rh factor, gangliosides, phosphorylation, and thiouracil. Incorporated in the text is much new material covering the recent advances in the field.

767 pages *106 tables* *$7.00*

On Approval Order Form

Sc 66

PAUL B. HOEBER, INC.
Medical Book Dept. of Harper & Bros.
49 East 33rd Street, New York 16

Please send me on approval:
☐ Barnard and Robb-Smith ☐ Everett

Name ....

Street ....

City .... Zone .... State ....

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Darkfield Quebec colony counter. A new, improved design of the Spencer Darkfield Quebec Colony Counter is now available. The front surface is inclined at an angle found to be most convenient to the average technician. An auxiliary tilting base can, however, be supplied when there is an individual preference for further adjustment. The scientifically designed reflector provides illumination, free from glare, uniform over the entire field, and adequately bright to reveal and distinguish small colonies from other structures. Emphasis has been laid on correct illumination to facilitate counting and to reduce fatigue. The 4½-inch lens, mounted on a sliding rod for focusing purposes, has the standard 1.5X magnification specified by the American Public Health Association. It is so positioned that errors from parallax are avoided. If required, additional magnifications can be provided by the addition of an auxiliary lens. When not in use, the lens and mount may be pushed down and out of the way. Wolffhiegel, Steward, and Jeffers guide plates are available. Centering screws are provided so that a Petri dish may be positioned when circular ruled plates are used. *Brochure M–84 246 SC–51.* American Optical Company, Scientific Instrument Division, Buffalo, N. Y.

New portable stroboscope. Model 1210, the newly developed stroboscope of Communication Measurements Laboratory, employs a novel circuit arrangement, using a self-blocking oscillator. Rotary or vibratory motion can be "stopped" when the moving object is examined with stroboscopic light source. The speed covered is from 600 to 48,000 r.p.m. (10–800 cycles per second), in four ranges. A synchronized reed is provided for accurate calibration against the line frequency. All four scales can easily and quickly be calibrated within – 3 per cent.

The light source is contained in a probe attached to a four-foot flexible cable. This feature makes CML 1210 useful when using the stroboscopic light in small out-of-the-way places. The light probe and cable are housed in the cabinet when the stroboscope is not in use. CML 1210 weighs only 19½ pounds and is housed in a compact cabinet, 10¼ × 5⅝ × 10¼ inches. *Descriptive Bulletin SC–51* may be obtained from Communication Measurements Laboratory, 120 Greenwich Street, New York 6, N. Y.

Resistance measuring instrument. A four-page bulletin has just been issued by James G. Biddle Company, describing three different types of their "Megger" instruments for measuring low resistance. These include the "Bridge-Meg" Resistance Tester—a combination Wheatstone Bridge and "Megger" Insulation Tester; the "Ductor" Low Resistance Ohmmeter, which operates by pointer deflection down to .000001 ohm; and the Midget "Megger" Circuit Testing Ohmmeter, which reads from a fraction of an ohm up to 200,000 ohms. Described in *Bulletin 1805 SC–51.* James G. Biddle Company, Philadelphia, Pa.

Sex endocrinology. The Schering Corporation has published an interesting and authoritative 88-page booklet on the history, chemistry, physiology, and therapeutic usage of the important hormones in modern medicine. It is profusely illustrated with informative diagrams and actual case photographs. The complexities of endocrinology are clarified, and the subject becomes readily understandable. *Sex endocrinology, Booklet SC–51.* Schering Corporation, Bloomfield, N. J.

Experimental dehydration unit. National Research Corporation is now manufacturing a small dehydration unit, Type 3501, for use in the laboratory or in pilot production. This unit is a complete unit for the desiccation or concentration of heat-sensitive biologicals, antibiotics, food products, and fine chemicals. The pumping system consists of a two-inch oil diffusion pump backed by a 12.5 c.f.m. mechanical pump, which is also used for roughing. Time required to pump down to 200 microns of Hg from atmospheric pressure is four minutes, and the blank-off is 1 micron or less. Water vapor is handled by a carbon dioxide and acetone (or alcohol) cold trap with a capacity of four pounds of ice. Three thermocouple gauges, at the fore pump, diffusion pump, and cabinet, indicate vacuum conditions. Provision for four thermocouples in the cabinet permits control of heat input. All controls and gauges are located on a central control panel.

The drying cabinet measures 16 × 16 × 24 inches, and it is possible to connect larger containers to the system by means of four outside nipples. The cabinet is equipped with three adjustable shelves electrically heated with a controllable input of 1 kw. For complete details request *Release 3501 SC–51.* National Research Corporation, Boston 15, Mass.

Miniature thyratron. A new miniature thyratron measuring only 2⅛ inches and mounted in a T–5½ bulb, suitable for many electronic control applications where equipment must be compact, portable, or light-weight, has been announced by Sylvania Electric Products, Inc., Radio Tube Division. The tube may be operated in any position and is not affected by ambient temperature. Typical ratings and characteristics of the type 6D4 miniature thyratron are as follows: heater voltage, a–c or d–c, 6.3 volts; heater current, 250 milliamperes; maximum voltage between elements, 450 volts; heating time, 30 seconds; maximum peak anode current, 100 milliamperes; maximum heater-cathode, voltage, – 100 volts, + 25 volts. Write for *Information Sheet SC–51.* Electronics Division, Sylvania Electric Products, Inc., 500 Fifth Avenue, New York 18, N. Y.

SCIENCE

Vol. 103, No. 2681 Friday, May 17, 1946

Medical Research Mission to the Soviet Union

A. Baird Hastings and Michael B. Shimkin

IN 1943 THE SOVIET GOVERNMENT suggested to the United States Government that there be an exchange of information on certain aspects of medical research of mutual interest to both countries. Appropriate steps to effect this were taken through the United States Embassy in Moscow, the Department of State, and the Office of Scientific Research and Development.

A series of 10 subjects in which there had been active, recent research developments in the United States were selected by the Committee on Medical Research of the OSRD, and reports on these subjects were prepared by American scientists for transmittal to the medical authorities of the Soviet Union. The subjects of the reports were: "British Anti-Lewisite," by Milton C. Winternitz; "Penicillin," by Robert D. Coghill and Chester S. Keefer; "Typhus Vaccine," by Norman H. Topping, Richard G. Henderson, and Charles C. Shepard; "Plasma Protein Fractionation," by A. Baird Hastings and Edwin J. Cohn; "Quinacrine," by James A. Shannon; "Surgical Problems—Wound, Burns, Shock," by Allen O. Whipple; "Insecticides," by W. E. Dove; "Air Sterilization," by O. H. Robertson; "Dermatophytosis," by J. Gardner Hopkins; and "Goggles for Military Use," by Walter R. Miles.

Because most of these problems had been developed jointly by investigators of Great Britain, Canada, and the United States and because there had been exchange of information among the workers, the Medical Research Council of Great Britain and the National Research Council of Canada were invited to participate in the exchange of information with the Soviet Union. The reports were sent to both organizations for their comments, criticism, and additions, and these were incorporated in the reports.

It was further agreed by the Governments of the Soviet Union and the United States that the reports should be delivered in person by representatives authorized to discuss them with designated Russian medical authorities. Vannevar Bush, director of the OSRD, appointed the authors to carry out this mission.

The medical authorities of Canada and of Great Britain were informed of these appointments and were asked whether they too desired to send personal representatives. H. W. Florey and A. G. Sanders, of Oxford University, were appointed to present the medical research developments of Great Britain with particular emphasis on the methods of laboratory production and clinical use of penicillin. The medical authorities of Canada delegated their representation to Drs. Florey and Sanders.

The report of the American representatives, submitted to the OSRD, has now been released. The major observations and conclusions, with additions to bring certain information up to date, are presented here.

ITINERARY

We arrived in Moscow on 14 January 1944 and left on 11 February.

After proper introductions had been made by the United States Embassy with the Soviet Foreign Office, a program of visits to laboratories and conferences was arranged by V. V. Parin. At the time of our visit, Prof. Parin occupied a position corresponding to that of A. N. Richards, chairman of the Committee on Medical Research. He taught physiology at the Third Moscow Medical Institute in the morning and attended to his activities in the Commissariat of Public Health in the afternoon and evening. Prof. Parin accompanied us on visits to three Institutes, but aside from this, we were not escorted by any government officials or interpreters. Our discussions with Soviet scientists were carried out freely and informally as scientist with scientist.

All-day visits were made and conferences held, in chronological order, at the following institutions:

Department of Physiological Chemistry, VIEM —21 January

Dr. Hastings is professor of biological chemistry, Harvard University Medical School, and a member of the Committee on Medical Research, OSRD. Dr. Shimkin is a surgeon in the U. S. Public Health Service and assistant chief of the Office of International Health Relations.

Institute of Hematology and Blood Transfusion	—24	January
Central State Medical Library	—25	"
Central Institute of Microbiology and Epidemiology	—26	"
First Moscow Medical Institute, preclinical and hospital	—28	"
Department of Education, Narkomzdrav	—28	"
Institute of Biology Section of Academy of Sciences	—29	"
Botkin Hospital	—31	"
Central Institute of Disinfection	— 1	February
Department of Biochemistry of Microbes and Immunity	— 2	"
VOKS	— 4	"
Medsantrud Hospital	— 5	"
Medical Research Council, USSR	— 5	"
Physiology Institute of Academy of Sciences	— 7	"
Neurosurgery Hospital in the name of Semashko, VIEM	— 8	"
Sklifasovski Hospital	— 9	"
Academy of Sciences, USSR	—10	"
Reception by Commissar G. A. Miterev	—10	"

We would like to make grateful acknowledgment to Commissar G. A. Miterev, Prof. V. V. Parin, Ambassador W. Averell Harriman, and members of the United States Embassy in Moscow for their many kindnesses to the mission.

ORGANIZATION OF MEDICAL RESEARCH IN THE SOVIET UNION

In 1941 there were 223 separate Institutes in which medical research was carried on in the Soviet Union. These institutions had 19,000 scientific workers of different degrees of training and competence on their staffs. Administration of these research centers is primarily under the Commissariat of Public Health and the Academy of Medical Sciences. A graphic presentation of the organization of medical research is given in Fig. 1.

Commissariat of Public Health.[1] Medicine and medical research is highly organized and administratively centralized in the Soviet Union. The chief government agency is the People's Commissariat of Public Health (Narkomzdrav, a combined abbreviation of *Nar*odny *Kom*issariat *Zdravo*-okhraneniya—literally, People's Commissariat of Health Protection). It was established in 1918, but since then has acquired additional responsibilities. In 1930, for example, all medical education was placed under it in order to expedite the desired increase in the medical personnel of the country. At present the Commissariat is the chief authority in all matters pertaining to the training of physicians, dentists, nurses, and subprofessional medical assistants, to the allocation of personnel and hospitals, polyclinics, and other medical establishments, and to the medical relief, sanitation, and prophylactic measures among the population. It supervises directly the production of drugs and biologicals, medical instruments, spectacles, etc. and has its own publishing house ("Medgiz") for medical books and journals. At the time of our visit it also supervised most of the medical research carried out in the Soviet Union. This has since been changed, as will be discussed later. One of the few activities usually associated with medicine over which it does not have jurisdiction is veterinary medicine.

In the Soviet Union the commissariats of the USSR are reduplicated in each Republic, in which matters of regional interest are handled. Thus, there is a Narkomzdrav SSR for the Ukraine, Belorussia, and the rest of the Soviet Republics. The heads of these SSR commissariats are selected by the Supreme Soviet of the Republic, with the approval of the Narkomzdrav of the USSR.

The present People's Commissar (now Minister) of Public Health of the USSR, a position roughly equivalent to a Secretary of our Cabinet but exceeding it in authority, is G. A. Miterev.

In 1943 the work of the Narkomzdrav USSR was divided among six vice-commissariats, each headed by a vice-commissar, as follows: therapeutic facilities and organization—S. A. Kolesnikov; medical research and education—V. V. Parin; personnel and hospital allocation—S. I. Milovidov; sanitation—A. Y. Kuznetzov; special medical industries—A. G. Natradze; and maternal and child affairs—M. D. Kovrigina.

Since our visit the vice-commissariat of research and education has been abolished, the research functions being transferred to the newly-formed Academy of Medical Sciences. V. V. Parin is now the secretary of this Academy. The department of education has been shifted under another vice-commissariat. N. N. Priorov has replaced Kolesnikov, who retains his post as head of the Soviet Red Cross and Crescent Society. A veterans' hospital department has been established under the vice-commissariat of hospital allocation.

The medical research institutes under the Narkomzdrav are directed with the advice of the 16 or 17 committees of the Medical Research Council (Uchonoi Meditsinki Soviet), which examine their research plans, personnel and equipment needs, and the budget. The members of the Council are selected by the Commissariat from among the outstanding scientists of the nation. The present president of the Council is N. N. Burdenko; I. P. Razenkov is the vice-president;

---

[1] In March 1946 the Supreme Soviet abolished the title of Commissar and substituted the title of Minister. The present proper designation for the Commissariat of Public Health, therefore, is the Ministry of Public Health. "Narkomzdrav" is now presumably "Minzdrav."

and L. A. Koreisha is the secretary. The decisions of the Council are transmitted to Narkomzdrav, where final decisions are made in meetings of the People's Commissar with his vice-commissars and departmental heads.

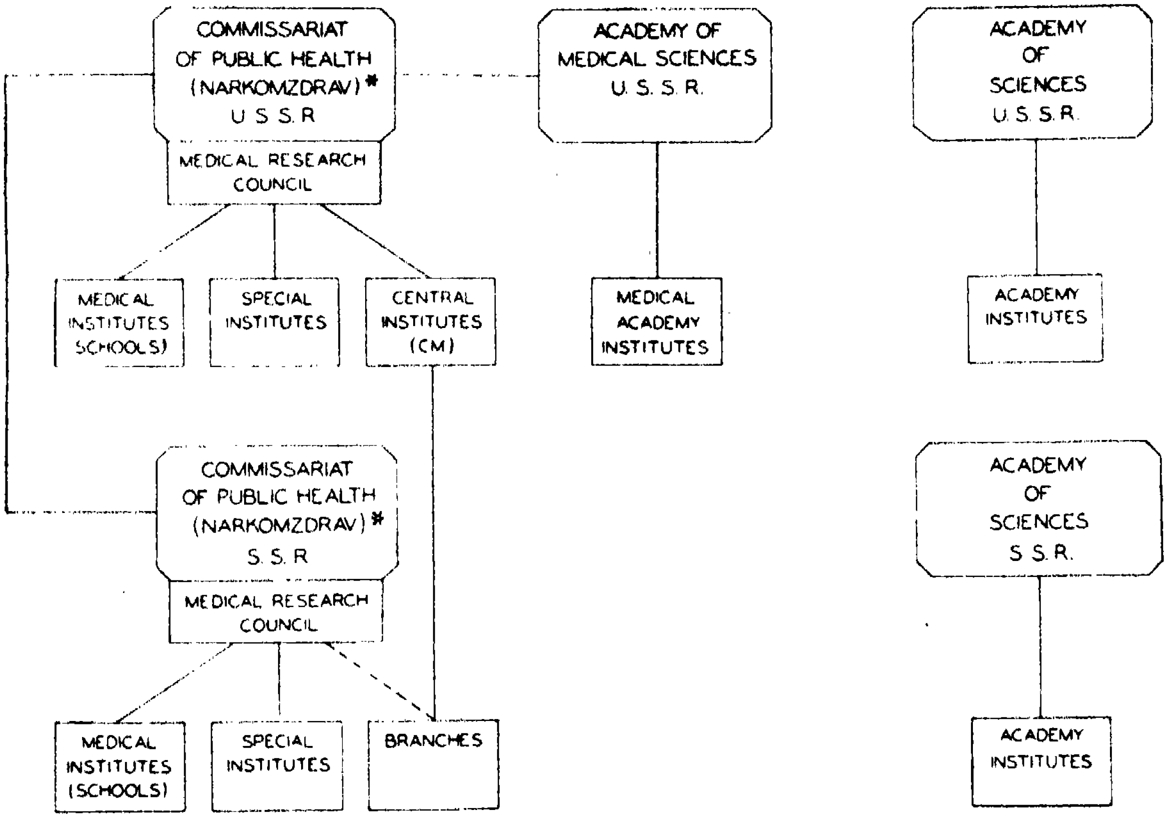

COMMISSARIAT OF PUBLIC HEALTH (NARKOMZDRAV)* U S S R
MEDICAL RESEARCH COUNCIL
ACADEMY OF MEDICAL SCIENCES U. S. S. R.
ACADEMY OF SCIENCES U. S. S. R.
MEDICAL INSTITUTES SCHOOLS)
SPECIAL INSTITUTES
CENTRAL INSTITUTES (CM)
MEDICAL ACADEMY INSTITUTES
ACADEMY INSTITUTES
COMMISSARIAT OF PUBLIC HEALTH (NARKOMZDRAV)* S. S. R
MEDICAL RESEARCH COUNCIL
ACADEMY OF SCIENCES S. S. R.
MEDICAL INSTITUTES (SCHOOLS)
SPECIAL INSTITUTES
BRANCHES
ACADEMY INSTITUTES

FIG. 1

Most of the institutes under Narkomzdrav are engaged in work on special problems of practical interest. Thus, there are special institutes of traumatology, prosthesis, orthopedics, industrial hygiene, sanitation education, etc. If the institutes have branches, the chief institute is designated as the Central Institute. The Narkomzdravs of the Republics have their own special institutes, which are directly under their jurisdiction and are not connected with the USSR institutions. We visited three of the Central Institutes and Special Institutes but none of the branch Institutes.

Included in the administration of the Narkomzdrav of the USSR is a group of 12 Central Institutes (CM), which by law must have a branch in each Republic of the USSR. The branches are budgeted through the local Narkomzdrav SSR, and the work is coordinated with local needs, but its chief research plans and directions emanate from the particular Central Institute of which it is a branch. The 12 Central Institutes are: (1) Tuberculosis, (2) Skin and Venereal Diseases, (3) Microbiology and Epidemiology, (4) Oncology, (5) Neurosurgery, (6) Endocrinology, (7) Otolaryngology, (8) Ophthalmology, (9) Plague, (10) Malaria and Tropical Diseases, (11) Obstetrics and Gynecology, and (12) Pediatrics. As is evident from the names, many of these are engaged chiefly in research directly related to clinical problems.

There are 51 medical institutes (schools), 21 stomatologic and pharmacologic institutes, and 11 postgraduate institutes in the Soviet Union. The 72 medical, stomatologic, and pharmacologic institutes are designated as Medvuz (combined abbreviation of *Med*itsinskii *v*ishiye *u*chebniye *z*avedenya, or medical-highest-educational-institutions). Each department of the medical schools is required to conduct scientific work as well as the teaching of students. The research programs of the departments are examined by a council of professors and approved by the dean of the school. In the case of four or five medical schools located in Moscow and Leningrad which are directly under the jurisdiction of Narkomzdrav USSR, the research programs are further reviewed by the Medical

---

* As of March 1946, Ministry of Public Health (Minzdrav).

Research Council and approved by the Commissariat. The remainder of the medical schools are under the jurisdiction of the Narkomzdravs of the Republics, and their research programs are examined and supported by the respective local commissariats.

The training of most of the individuals engaged in medical research is in the medical schools and institutes. The Soviet educational system has a primary education of seven years and three years in the so-called middle schools. Applicants to medical schools have to complete the 10-year course and are admitted on the basis of competitive examinations. The medical curriculum was increased from five to six years in December 1944 and in general follows the American plan. Graduates are given the title of Vrach (physician). Outstanding students may take postgraduate research or clinical training, and the successful completion of a three-year course leads to the title of Candidate of Medical Sciences. The title of Doctor of Medical Sciences is granted upon further work of an original character. Professorships of medical schools, directorships of research laboratories, and positions of similar importance are filled from among physicians and scientists who have attained the degree of Doctor of Medical Sciences.

Academy of Medical Sciences. The Academy of Medical Sciences was organized in 1944. It has 60 founding members, and additional members have been selected subsequently. Its president is N. N. Burdenko, and its secretary, V. V. Parin.

The Academy of Medical Sciences is divided into three sections: (1) medical-biological sciences, (2) hygiene, microbiology, and epidemiology, and (3) clinical medicine.

The Academy absorbed the All-Union Institute of Experimental Medicine (VIEM), which had some 13 departments in Moscow and 6 in Leningrad.

The medical-biological section of the Academy is made up entirely of institutes formed from the VIEM, and the section on clinical medicine includes the neurology clinic of the VIEM. The primate station in Soukhoumi serves the needs of the Academy as a whole. The personnel previously under VIEM numbers about 2,000, of which 500 are scientific workers and, of those, 85 are of professorial rank. N. I. Grashchenkov, the previous director of VIEM, is now one of the vice-presidents of the Academy of Medical Sciences.

In addition to the VIEM, certain special institutes, such as the Central Institute of Hematology and Blood Transfusion, have been incorporated under the Academy. The total number of institutes under the new Academy is now approximately 25. Selection of the institutes was apparently made on the basis of scientific achievement and importance of such institutions, and the main objective appears to be to strengthen fundamental medical research rather than the practical research and development characteristic of the institutes directly under Narkomzdrav.

Administratively, the Academy of Medical Sciences is coordinated with the Narkomzdrav USSR, particularly in regard to its budget. So far, none of the Republics has established corresponding Academies of Medical Sciences at their levels.

It should be emphasized that the administrative structure of medical research, as presented in Fig. 1, is not rigid. Individual institutes may be transferred, split, or combined, depending upon their growth and development. The official position of the director of an institute does not determine its administrative place. Moreover, one individual may, and often does, hold several posts simultaneously and may direct more than one institute.

Academy of Sciences, USSR. No discussion of research in the Soviet Union would be complete without noting the Academy of Sciences, the top scientific body of the country. It was organized in 1724 and at present has over 200 members and 300 corresponding members. The full members are designated as Academicians and are afforded a special position of honor in Soviet society.

The Academy has seven large divisions: (1) biology, (2) chemistry, (3) physics-mathematics, (4) geography, (5) social sciences, (6) technology-engineering, and (7) arts and literature. The biology division, whose chairman and vice-president of the Academy is L. A. Orbelli, has 12 institutes, of which 9 are in Moscow and 3 in Leningrad.

There is no direct connection between the Academy and the Narkomzdrav, although the Academy is naturally well represented on the Medical Research Council. The budget of the Academy is separate from that of the Narkomzdrav.

Five of the Republics—Ukraine, Belorussia, Uzbekistan, Armenia, and Georgia—have their own Academies of Sciences. These are entirely separate from the USSR Academy and are of regional importance and significance. Some of these Academies of Sciences SSR have their own institutes.[2]

An account of visits to individual laboratories and hospitals is to be published in next week's issue of *Science*.

[2] For more detailed accounts of the Academy of Medical Sciences and its incorporation of the VIEM, see N. I. Propper-Grashchenkov (*Amer. Rev. Soviet Med.*, 1944, 2, 108) and J. Heiman (*Amer. Rev. Soviet Med.*, 1945, 3, 64); of organization of medical education, M. B. Shimkin (*Amer. Rev. Soviet Med.*, 1944, 1, 465); of the Academy of Sciences, USSR, F. E. Brasch (*Science*, 1944, 99, 487).

Functions and Development of a Tropical Marine Laboratory

F. G. Walton Smith
University of Miami Marine Laboratory

A LITTLE OVER TWO YEARS AGO, the late Dr. Thomas Barbour was kind enough to draw attention to the newly organized Miami Marine Laboratory (*1*). With the end of the war and the focusing of attention once more upon peacetime objects of investigation, the present time is well suited to a discussion of the activities which would justify any considerable expenditure of energy and money in the future development of a tropical marine station. The increase in number of marine laboratories during the past half century renders it particularly important that a new station should fulfill a real need and that it should neither overlap in function the older, established institutions nor merely add unnecessarily to the number of smaller seaside laboratories. For this reason, considerable thought has been given at Miami to the possibility of developing aspects of marine biology and oceanography which are particularly suited to the area or which are not already being adequately covered elsewhere.

The growth and development of the sciences which converge in marine biology and oceanography arose from the early expeditions following Captain Cook's voyage in 1768. Further expeditions in which oceanographic sampling and other techniques were introduced took place in later years, culminating in the specialized cruises of the present day.

The work that ocean cruises are able to accomplish is limited, although it is indispensable for a knowledge of the fauna and flora of the open sea, of the nature and organisms of the sea bottom, and of the ocean currents and physical characteristics far from shore. It is not suited, however, for anatomical, histological, physiological, and embryological inquiries, for long-term investigations into seasonal variations of seawater and its plankton, or for close and careful coastal ecological studies. The need for these investigations brought into existence numerous seacoast laboratories after the opening of the celebrated Naples station, in 1872. These are to be found, with few exceptions, on seacoasts in temperate latitudes, and, as a result, the classical work in marine biology and oceanography refers principally to the open ocean or to these temperate shores. The centers of population and civilization are at neither the Poles nor the Equator but are in the temperate latitudes, while the great fishing industries are based on the chemically rich, shallow banks of the temperate Atlantic and Pacific. There have been no equivalent stimuli to marine biological and oceanographical investigations on tropical shores.

The volume of work turned out by stations in the temperate latitudes has been remarkable, and it is now true that the broad general features of the physics, chemistry, and biology of coastal waters in the higher latitudes have been blocked out. The general characteristics of the open oceans are also known in certain broad fundamentals.

In contrast, our ignorance of tropical shores and waters adjacent to them is profound. This is not hard to understand when we enumerate the marine laboratories of the tropics. One of the earlier tropical stations was that founded by the Carnegie Institution at Dry Tortugas, Florida, faunistically within the tropics, although geographically just outside. Inaccessibility was one of the factors that forced this station to close, much as it brought about the closure of Agassiz's laboratory on the island of Penikese. Some 40 years ago a station was opened on Bermuda which, although not in the tropics, was sufficiently close to them and sufficiently under the influence of the Gulf Stream to support a relatively impoverished tropical ocean fauna. This was closed during World War II, and now that it is again open, its comparative inaccessibility may somewhat restrict its usefulness, although its value as an oceanic base must not be underestimated. There are also small stations in the Philippines, in Hawaii, and at the University of Texas.

In addition to this hiatus in our knowledge of marine biology and oceanography, there is a further argument that may be advanced in favor of a tropical marine laboratory. It would fulfill a definite demand in providing unusual advantages for the study of the constituent sciences themselves, considered independently of oceanography. The terrific competition for food and space on the living coral reefs and the enormous variety of species, of adaptations, of feeding habits, and of methods of attack and defense, make it a classroom and a workshop for the study of fundamental branches of biology. Furthermore, the physiologist, behaviorist, ecologist, embryologist, or biochemist who uses marine animals and plants merely because of their convenience and not because of an interest in the ocean is immensely benefited by being able to work at a tropical station where the organisms are active the year round.

These conditions exist in the Miami area. Not only is it tropical in the sense that its *shores* harbor the representative West Indian flora and fauna, but it also has accessibility, lack of which contributed to closing of the Dry Tortugas laboratory. Ocean beaches, mangrove swamps, and wide areas of coral reefs, shallow water, and flats form only part of the extraordinary variety of environmental conditions. The coral reefs are in shallow water so that collecting with a diver's helmet is perfectly practicable, and the Gulf Stream is closer than at any other part of the Atlantic Coast.

The islands of the West Indies and of the Caribbean Sea have many interesting problems. Various factors have made it difficult to establish a satisfactory marine laboratory on these islands, although this has been proposed many times and has again been broached in recent years (*2, 3*). The problems of the West Indies, however, are the problems of south Florida, and the accessibility of Miami by airplane, railroad, and boat, from the West Indies and the scientific centers of the United States alike, increases the opportunity for studying these problems here.

The above reasons, coupled with the necessity of carrying out certain phases of marine research important to the prosecution of the war in tropical waters, brought about the Miami Marine Laboratory as a logical process, greatly assisted by the cooperative interest of the Woods Hole Oceanographic Institution.

In order that the geographical advantages of the location may be utilized to their fullest extent, the aims and functions of the Laboratory are being formulated with care. In the first place, it is realized that in order to attain its widest usefulness a tropical laboratory must be more than a mere adjunct of one university. It must provide a definite service for biologists at large, and the requirements and opinions of these biologists must be considered in the further development of the institution.

It is further realized that in order to develop our knowledge of tropical oceanography and biology it is not sufficient to provide facilities for visiting investigators. There must be a permanent staff, however small, to work within a definite program of investigation, correlated with investigations already completed and others still continuing in temperate latitudes.

It is believed that a proper balance should be struck between academic and applied investigation, and that *to some extent each gains by its proximity to,* and relations with, the other. On the academic side the investigations which have been considered include biological studies of the more important marine flora and fauna, from the viewpoints of taxonomy, embryology, physiology, and ecology; the studies of seasonal plankton variations and their relations to chemical and physical conditions of the bay and open ocean; and the general question of total organic productivity. Hydrographical studies, including the dynamics of the Gulf Stream, should be carried out in collaboration with institutions engaged in this work elsewhere.

Applied marine science in the tropics has been somewhat neglected. Certain fields, such as sea-water corrosion, ship-fouling prevention, and preservation of submerged structures, may be investigated in the tropics with especial advantage, because of the enhanced rate at which the destructive agencies operate as compared with temperate waters, and because of the year-round opoprtunity for field work, unimpeded by climatic changes.

Not only south Florida but the whole of the West Indies are backward in the investigation of marine industries, except where they are of such a nature that Federal agencies may be called in. The natural production of these latitudes is lower than that of temperate regions, the importance of fisheries varying accordingly. Nevertheless, a limited program of fisheries work is justifiable, and it is hoped that future developments may fall somewhat in line with the recommendations of the Anglo-American Caribbean Commission (*4*).

The fishes that might provide reasonably large-scale commercial fishing in the West Indies are, with certain exceptions, the pelagic migrants, so that the most obvious phase of the work is the investigation of movement, life histories, and spawning habits of migratory fish, as well as the study of local fish.

Investigations of edible marine products not hitherto utilized will tend to ensure more economical operations for fishermen. The investigation of methods of handling may bring about the same end and should not neglect the methods of handling used at sea. The fisheries technologist should be concerned with the effectiveness of types of fishing gear employed, the collection of fishery statistics, and the evolution of sound conservation methods. The biochemist has his problems of utilization of by-products and the toxicology of tropical fish poisoning.

Training in the various fields of tropical marine science is equally important. Articles in the national journals of at least two countries have expressed the desirability of instruction in tropical biology as a part of the training of every professional biologist (*1, 3*). This is particularly true in view of the economic development of tropical countries in recent years. In keeping with the general policy, it is felt not only that courses should continue to be given by the staff of the Marine Laboratory, but that as facilities are increased, the faculties of inland and northern universities and schools should be encouraged to bring field classes here during vacation and, should they wish, give instruction themselves at times when the regular courses are not offered.

The educational plans of the tropical marine laboratory should also include consideration of the advisability of technical training, not only in the form of advanced academic and technological training for marine scientists and fisheries officers, but also a practical vocational short-term intensive training of fishermen selected for their leadership in the various communities of Florida and the West Indies, where government scholarships would be needed.

This program is, of course, ambitious and comprehensive. It will have served its purpose if put into practice in a few directions which appear most practical and receive the most encouragement. The program is, in fact, already being realized to some extent.

Seasonal changes in the chemical and physical content of the sea water, including phosphate, nitrite, salinity, and dissolved oxygen, are being studied by monthly observations at 11 stations chosen for their wide ecological differences. At these stations simple quantitative and qualitative plankton determinations are made. Parallel observations are being made on organisms attaching to the underside of floating rafts, in such a manner as to provide evidence not only of seasonal changes but also of succession.

The teaching program has not been neglected, and the elementary courses in marine botany and zoology started over 15 years ago are still being continued. In addition, graduate courses are now offered in the University in the fields of oceanography and marine biology. These include courses in oceanographical physics and chemistry, marine algology, the biology of fishes, ecology, including statistical fisheries techniques, and invertebrate taxonomy and embryology.

In applied fields of science the facilities and personnel of the Laboratory have been utilized by various naval and military groups and by the Woods Hole Oceanographic Institution for work of importance to the war effort. Surveys of the behavior and distribution of fouling organisms are now being continued independently by the staff. Preliminary work is also being carried out on deterioration of cordage in sea water and the influence of marine bacteria in deterioration of lubricated metal surfaces. A study has been made of the rate of growth, productivity, and the chemical utilization of tropical marine algae.

In spite of handicaps, a start at least has been made in the field of fisheries research, and an investigation is at present being conducted into the Florida spiny lobster industry, in collaboration with the State Conservation Department. A similar survey has also been organized for the Bahamas Government, utilizing government personnel. The use of the loggerhead sponge and other hitherto valueless marine products as a source of organic fertilizer has been investigated.

Since it has been suggested in some quarters that a tropical marine laboratory in south Florida or the West Indies should be part of a tropical biological laboratory covering both marine and terrestrial phases, mention may also be made of activities not strictly within the field of marine biology.

A relatively new field is the study of causes and methods of preventing deterioration of various materials and equipment under semitropical conditions such as exist in the mangrove swamps and the damper parts of the Everglades. The peacetime significance of this type of work, in which the Miami Marine Laboratory has recently been associated with an industrial laboratory under military contract, is becoming increasingly obvious. Fabrics, all types of electrical and other equipment and machinery, and the materials and finishes employed in building and vessel construction are subject to deterioration from the effects of salt air, moisture, and fungus growth in the tropics, and with increasing competition for trade in tropical countries, this factor will assume even greater importance. In south Florida field tests as well as laboratory investigations are possible in the mangrove and Everglades swamps.

The present quarters are of a temporary nature and do not offer altogether suitable accommodations for the staff, equipment, and motor vessel. Funds for operation are received partly from irregular contributions from other institutions, governmental agencies, and industrial concerns in return for participation in specific projects and partly from the general funds of the University of Miami. In order to facilitate further development it will be necessary to secure a permanent building and a more regular and extensive source of funds, not merely for specific projects but for general upkeep and maintenance, for the sustaining of fundamental research, and for provision of hospitality to visiting investigators.

The problem of a permanent building may shortly be solved. The Dade County Commission has agreed to collaborate with the University of Miami by building a $2,000,000 Oceanarium and Marine Laboratory. The Oceanarium is being planned by, and will be operated under, the direction of the Marine Laboratory staff, and adequate modern laboratory facilities will be provided.

Future development will depend upon the extent to which the facilities are utilized. In order that growth of the Laboratory may take place along the lines of greatest benefit to the sciences concerned and in order to encourage future participation and support, the recommendations and suggestions of interested scientists will be welcomed.

References

1. Barbour, T. *Science*, 1943, 98, 141–145.
2. Chapman, V. J. *Nature, Lond.*, 1943, 152, 47.
3. Yonge, C. M. *Nature, Lond.*, 1943, 152, 136.
4. ———. *Report of the Anglo-American Caribbean Commission to the Governments of the United States and Great Britain, 1942–1943.* Washington, 1943.

Obituary

Edwin Bissell Holt

1873-1946

Psychology and the world of knowledge in general lost an original and a universal mind in the death of Edwin Bissell Holt on 25 January 1946. Though the formal recognition accorded to him during his life was scarcely proportionate to his greatness, his name will occupy a prominent place when the historian records the uneven progress of psychology in the first part of the Twentieth Century.

E. B. Holt was one of that brilliant group of students of William James who became influential not as exponents of a James system of psychology but as founders of the science of psychology in this country. From 1901 to 1919 Holt was a member of the psychology faculty at Harvard University; from 1926 to 1936 he was visiting professor at Princeton.

His *Concept of consciousness* (1914) anticipated his motor theory of psychology and was more important philosophically than psychologically. His *Freudian wish* (1915), however, has become a classic in American psychology. Academic psychologists, working in their laboratories, had developed an account of man as an assembly of sense organs and reflexes. Freud, working as a physician dealing with mental disorder, had produced world-shaking theories about the motivation of human behavior. Traditional academic psychology saw no way of relating its world of discourse to the Freudian realm. It was the genius of Holt that translated and modified Freudian doctrines into the terms of behavioral science. The progress of psychology in the past 30 years has been, to a considerable extent, the implementing and elaborating of Holt's contribution in *Freudian wish.* This work is also a milestone because it rejected the artifactual elementarism of the time and emphasized the importance of regarding behavior not as the summation of reflexes but as a function of the field of forces.

Holt is perhaps best known for his motor theory. The early behaviorists repudiated the conventional areas of psychology relating to conscious experience and concentrated upon a study of behavior. The effect of Holt's teachings was to strengthen this movement, but his own motor theory was much in advance of Watsonian doctrine. It attempted to deal with all conscious experiences by identifying them with their motor patterns of response. Many experimental studies in thinking and perception stemmed from the Holtian theory. Unfortunately, little of Holt's work on the problem was in print until *Animal drive and the learning process* appeared in 1931. This work was as late in relation to public interest as his *Freudian wish* had been early. If *Animal drive* had appeared 10 years earlier, it would have given the behavioristic movement a rationale, a perspective, a balance, and a sophistication which it desperately needed. Nevertheless, this work remains the most complete and the most scientific account of human psychology from a mechanistic or materialistic approach. It combines the philosophical recognition of the important problems of the older European writers with the scientific discoveries in modern neurology and psychology. Unfortunately, Holt ignored the entire area of constitutional and glandular factors in the determination of human nature and made no serious attempt to evaluate the evidence in this field. His account of man suffers, in consequence, from a neglect of the internal chemical environment of the organism.

The breadth of Holt's mind is indicated by mentioning two more specific contributions, one to epistemology and the other to social psychology: (1) The Berkeley doctrine of idealism, which asserts that reality inheres not in a world external to ourselves but in our sensations and ideas, never received as systematic and psychologically devastating an answer as Holt's article in the *Psychological Review* of 1934 which exposed the fallacious psychological assumptions on which Berkeley rested his argument. (2) In the social field Holt suggested the fundamental approaches and swept aside the pious hokum and verbalism that sometimes passes as social science. At Harvard, his lectures in Social Psychology comprised one of the first courses to be offered in this field. A cryptic summary of his contribution can be found in his article, "The whimsical condition of social psychology and of mankind," which appeared in *American Philosophy Today and Tomorrow* (1935).

The discrepancy between Holt's real influence on American psychology and its recognition was due to his indifference to the accepted institutional channels of the profession. He did not attend meetings or present papers at conventions; he set no store by quantitative publication in the journals.

Holt was probably the last great American psychologist in the European tradition of philosopher-scientist. His own experimental studies were few, but his systematic formulation of theory and his wise and brilliant evaluation of research findings suggest that there is still a place for the philosopher-scientist—even in modern psychology.

Daniel Katz

Brooklyn College

Technical Papers

The Purification and Crystallization of *Clostridium botulinum* Type A Toxin[1]

Carl Lamanna, Olive E. McElroy, Lt. (jg), USNR, and Henning W. Eklund, Ensign, USNR[2]
Camp Detrick, Frederick, Maryland

A preliminary report is presented of a method which has permitted the isolation at will of highly toxic needle-shaped crystalline protein material from a Type A culture of *Clostridium botulinum*. Electrophoretic analysis shows a single component.[3] The capacity of this material to react in a flocculation test with commercial antitoxin and to have its pharmacological activity neutralized by such antitoxin suggests the isolation of the Type A toxin concerned in food poisoning. The method builds upon the basic observations of Snipe and Sommer *(3)* and Sommer *(4)* that the toxin is acid precipitable from culture medium and can be eluted from the acid precipitate by buffer solutions at appropriate pH values.

Five-gallon carboy lots of a 0.3-per cent casein, 0.5-per cent glucose, and 1.0-per cent alkali-treated corn steep liquor medium *(1)* at pH 7.2 are inoculated and held at 34° C. until a maximum titer of toxin appears. This usually takes 72 to 80 hours. The method of purification and crystallization is as follows:

Step 1: The cultures are precipitated at pH 3.5 by addition of 2 N HCl. All acid-precipitable material, which includes toxin, nucleic acid, undigested casein, material from corn steep, and the organisms, is allowed to settle out overnight. The supernatant is siphoned off, and the precipitate collected in centrifuge tubes (250 ml.) at 1,800 r.p.m. The mud is washed once by resuspension in distilled water and recentrifugation.

Step 2: The washed acid mud is resuspended with the help of a Waring blender in distilled water to a volume of 300–400 ml. for each carboy of culture originally precipitated. This volume is referred to as original volume. Sodium chloride is added to one molar and sodium acetate to 0.075 molar concentration, and the pH adjusted to 6.5.

Step 3: The suspension is centrifuged at 1,800 r.p.m. to remove the coarse particles. To the supernatant one-sixth to one-tenth of its volume of c.p., chloroform is added and the mixture shaken vigorously for five minutes under CO_2. The pH drops to 5.8–6.1. The gel and excess chloroform are centrifuged off. If the original culture has 800,000 or more intraperitoneal 20-gram mouse MLD/ml., the aqueous supernatant will contain 15–30,000,000 MLD/ml. After the chloroform shaking, the pH of acid precipitation of the toxin in the presence of 1-per cent salt solutions changes from 3.5 to 5.0. The new pH value of acid precipitation is used in Step 5. In a future paper we hope to present data that permit some understanding of the function of shaking with chloroform in the purification procedure and the reason for the new pH value of acid precipitation.

Step 4: To the supernatant of Step 3, $(NH_4)_2SO_4$ is added to 20 per cent saturation (14 grams $(NH_4)_2SO_4$/100 ml. of solution). After refrigeration overnight the toxic precipitate which forms is centrifuged off. This step and the following one remove the bulk of nucleic acid present.

Step 5: The toxic precipitate of Step 4 is resuspended to three-fourths original volume in 0.075 M sodium acetate at pH 6.5–6.7. The pH is dropped to 5 with HCl, and the resulting precipitate allowed to settle out in the refrigerator. The pH 5 precipitate is centrifuged out and resuspended at pH 6.5 in molar sodium chloride and 0.075 M sodium acetate to one-third the original volume. In this mixture of salts the toxin is no longer precipitable at pH 5.

Step 6: The pH is then dropped to 5. Solid $(NH_4)_2SO_4$ is added in increments of 5 per cent saturation (3.5 grams/100 ml. of solution) up to 20 per cent saturation. The precipitates appearing on each addition of 5 per cent saturation are collected separately by centrifugation. The 20-per cent saturation precipitate is usually pure white and upon resuspension in 0.075 M sodium acetate gives a perfectly clear solution. The color of the 15-per cent saturation precipitate will vary from batch to batch. The 10 per cent precipitate is usually highly colored. The 5 per cent precipitate is usually not very abundant, is deep brown in color, and is discarded.

Step 7: The 20 per cent and 15 per cent precipitates are redissolved in 1/300 of the original volume (at least 240,000,000 MLD/ml.) of 0.075 M sodium acetate at pH 6.5. $(NH_4)_2SO_4$ is added, 0.1 gram/10 ml. at a time, to a total of 0.9 gram/10 ml. of solution. Any brown material remaining usually precipitates and can be centrifuged off. The resulting clear liquid has additional $(NH_4)_2SO_4$ added to give turbidity. After standing overnight in the refrigerator, the material coming out of solution is crystalline.

---

[1] Studies conducted at Camp Detrick, Frederick, Maryland, from June 1944 to August 1945.

[2] With the technical assistance of PhM1c J. F. Valentine, PhM3c N. Harmand, and HA1c S. Biscardi.

[3] We wish to thank Lt. G. Kegeles for his studies of the electrophoretic characteristics of the toxin.

Step 8: The color of the precipitates of Step 6 has varied from batch to batch. In those cases where the precipitates remained fairly highly colored they were reworked in the following fashion. The precipitates are resuspended in molar NaCl and 0.075 M sodium acetate at pH 6.5. Insoluble material is centrifuged off and discarded. The pH is dropped to 4.0, and precipitated material is centrifuged off. This precipitate can be reworked as many times as is necessary for complete recovery of toxin. To the supernatant at pH 4.0 after centrifugation enough solid $(NH_4)_2SO_4$ is added to give 15 per cent saturation. After standing in the refrigerator the white toxic precipitate is centrifuged off and can be crystallized (Step 7). In the salt solution down to pH 3.5 the toxin apparently remains more soluble than the brown contaminating material. This fact makes the separation possible. The pH of acid precipitation of the toxin is dependent on the nature and quantities of salts present.

Crystallization from the acetate buffer has been obtained in the pH range of 5.5–7.1. It appears as though supersaturation on the alkaline side of the isoelectric point by a variety of means will result in crystallization. Adding sufficient $(NH_4)_2SO_4$ to reduce the solubility of solutions of amorphous material given the most rapid and consistent results. But $MgSO_4 \cdot 7H_2O$ and Na_2SO_4 may be used in place of $(NH_4)_2SO_4$. In some cases slow evaporation at room temperature of concentrated solutions of the toxin in acetate buffer at pH 6.5 results in crystallization.

Crystal size has been found to be dependent on the speed with which the toxin is salted out from the supersaturated solution. Apparently the fewer nuclei present, the larger the crystals obtained. Two rapid methods of obtaining large crystals are used: (a) In the case of a solution in which crystallization is going on, centrifuge off the crystals coming out first. Place the clear supernatant in the refrigerator. The crystals then coming out of solution are of a larger size than the first material. (b) Place a drop of slightly turbid crystalline suspension on a clean glass slide and cover with a cover slip. At room temperature let some of the solution evaporate from the sides of the cover slip. Then seal the preparation with paraffin and place in the refrigerator. After the large crystals have formed (few hours to overnight) by growth from smaller ones, the preparation can be kept at room temperature without disruption of the crystals. Crystals 125 µ in length and 7 µ in width have been obtained. Others average about 85 µ by 5 µ. A tendency for the crystals to line up in parallel rows with no tendency to collect in rosettes has been observed.

Recrystallization has been accomplished by supersaturation of distilled water solutions. A minimum amount of distilled water at room temperature at pH 7–8 is used to dissolve the material to be recrystallized. The pH tends to drop as the toxin goes into solution. When placed in a refrigerator, the material coming out of solution appears as the same-shaped needle-like crystals noted for the buffer solutions.

The degree of purity attained by the method is suggested by the data in Table 1.

TABLE 1

SOME BASIC DATA FOR PURIFIED *Clostridium botulinum* TYPE A TOXIN

Observation		Batch of Toxin	
		C42E	Crystalline
Nature of materials		Amorphous	C38
Electrophoresis data* pH 4.44, acetate buffer	No. of components	One	One
	Mobility, $V_D(10)^5$ Cm.^{2}/volt/sec.	+ 3.2	+ 3.4
MLD/mg. nitrogen†		120.7×10^6	......
LD_{50}/mg. nitrogen‡		198.5×10^6	239.9×10^6
Mg. nitrogen/MLD		8.3×10^{-9}	......
Mg. nitrogen/LD_{50}§		5×10^{-9}	4.2×10^{-9}
Adamkiewicz test (tryptophane)		Positive	Positive
Molisch test		Negative	Negative

* Data obtained by Lt. G. Kegeles.

† MLD is defined as the smallest amount of material injected intraperitoneally which will kill six out of six 18- to 20-gram white mice within four days time.

‡ LD_{50}—calculated by R. A. Tiede by the method of Bliss (*Ann. appl. Biol.*, 1935, **22**, 134, 307).

§ Pickett, Hoeprich, and Germain (*J. Bact.*, 1945, **49**, 515–516) have reported the isolation of tetanus toxin giving $2.3–5.7 \times 10^{-5}$ mg. N_2/mouse MLD. This is the most potent toxic material known to us that has been previously reported.

The similar electrophoretic mobility for both amorphous and crystalline material is a strong argument for the isolation of a single toxic substance. The rapidity of crystallization and the agreement of data on the LD_{50}/mg. of N_2 for both types of materials are equally suggestive of a high degree of purity. The ordinary chemical tests for protein such as the Biuret and Millon's are positive. The nitrogen content is 14.3 per cent. The molecular size as indicated by the membrane diffusion method of Northrop and Anson (*2*) is rather large. Assuming a spherical shape, the radius of the molecule lies between 7.7 and 9.1×10^{-7} cm. These data suggest a molecular weight between 1,000,000 and 2,000,000. The immoderate spread in these data is attributable to a large variation in the animal titrations used for measuring the toxic diffusate. Both impure and crystalline toxin were used in making the determinations.

References

1. LEWIS, K. H., ELBERG, S. S., and LAMANNA, C. Unpublished data.
2. NORTHROP, J. H., and ANSON, M. L. *J. gen. Physiol.*, 1928–29, **12**, 543.
3. SNIPE, P. T., and SOMMER, H. *J. infect. Dis.*, 1928, **[illegible]**, 152.
4. SOMMER, H. *Proc. Soc. exp. Biol. Med.*, 1937, **35**, 520.

The Isolation and Crystallization of Tetanal Toxin[1]

Louis Pillemer, Ruth Wittler, and
Donald B. Grossberg
Institute of Pathology, Western Reserve University

A toxic protein from the filtrates of *Clostridium tetani* identical in behavior to tetanal toxin (spasmin) has been isolated and crystallized in this laboratory. The crystalline material contains between 3,500 and 4,000 flocculating units (Lf) and between 50,000,000 to 75,000,000 mouse minimal lethal doses (MLD)/mg. of nitrogen. This Lf value compares favorably with the figure of 3,300 Lf/mg. of nitrogen estimated on the basis of combining nitrogen to be the true Lf value for pure tetanal toxoid (*2*). The MLD content of the crystalline protein/mg. of nitrogen is at least 200 times greater than the purified toxin prepared by Eaton and Gronau (*1*), and also at least 50 per cent greater than the purest preparations of Pickett and co-workers (*4*).

TABLE 1
General Procedures

Preparation	No.	Mg. N/ml.	MLD/ml. $\times 10^6$	Lf/ml.	Kf* in min.	MLD/mg. N $\times 10^6$	Lf/mg. N	MLD/Lf $\times 10^4$	Yield Per cent of parent toxin
Parent toxin	..	3.01	0.2	20	15	0.066	6.6	1.0	..
Material insoluble in 40% MeOH at pH 5.2, μ 0.09, and temp. −5° C. Precipitate dissolved in 0.15 M sodium acetate.	1	0.320	5	300	10	15.6	937	1.66	95
Precipitate 1 adjusted to 15% MeOH at pH 5.5, μ 0.03, and temp. −4° C. Precipitate dissolved in 0.15 M sodium acetate.	2	0.172	4	250	10	23.2	1453	1.6	90
Precipitate 2 adjusted to 12% MeOH at pH 4.0, μ 0.075, and temp. −4° C. Precipitate discarded. Supernatant employed.	3	0.054	1.8	112	10	33.3	2074	1.6	83
Supernatant 3 adjusted to 30% MeOH at pH 4.0, μ 0.02, and temp. −6° C. Precipitate discarded. Supernatant employed.	4	0.034	1.5	90	10	44.1	2646	1.66	80
Supernatant 4 adjusted to 25% MeOH at pH 5.1, μ 0.02, and temp. −8° C. Crystals and slight amount of amorphous material formed precipitate.	5	0.041	2.25	140	10	54.9	3415	1.6	60
Precipitate 5 recrystallized as in No. 5. Crystals formed precipitate.	6	0.022	1.5	80	10	68.1	3636	1.87	45
Precipitate 6 recrystallized three times as in No. 5. Crystals formed precipitate.	7	0.015	1.0	55	10	66.6	3666	1.81	27

* Kf determined at 20 Lf units.

The method employed for the purification and crystallization of the toxin involves the use of methanol under rigidly controlled conditions of pH, ionic strength, protein concentration, and temperature (*5*). The parent tetanal toxin used in this study was prepared by the method of Mueller and Miller (*3*). The major steps in the isolation and crystallization of the toxic protein are summarized in Table 1, together with assays and analyses of the various fractions. It will be noted that the activity of the crystalline toxin/mg. of nitrogen has been increased more than 500 times on an Lf basis and 800 times on an MLD basis over the parent toxin filtrates. Four crystalline preparations show a remarkable constancy in the Lf and MLD contents/mg. of nitrogen. The Lf and MLD units/mg. of nitrogen remained constant during three additional recrystallizations. The yield per liter of parent toxin filtrate is less than 1 mg. of nitrogen.

Crystallization of the toxic protein occurs slowly at −8° C. under the conditions shown in Table 1. The crystals disintegrate rapidly at temperatures above −5° C. and dissolve in the mother liquor at temperatures above 0° C. This behavior has presented technical difficulties in microphotographing the crystals. However, a sketch of the crystals is presented in Fig. 1.[2]

The colorless crystals dissolve instantly in 0.15 M sodium acetate at pH 6.5. The solution gives positive reactions with protein reagents. Both the Molisch test and the nitroprusside test are negative.

---

[1] Aided by a grant from Wyeth, Inc.

[2] We are indebted to Theodora Bergsland, medical artist at the Institute of Pathology, Western Reserve University, for her painstaking sketch of the crystals.

The crystals appear uniform and possess constant biological activity upon recrystallization. Their activity is destroyed by heat, acid, or alkali. This would indicate that the crystalline protein is identical with tetanal toxin.

Complete chemical, physical, and biological characterization of the crystalline toxin will have to await the accumulation of larger quantities of material. The detailed procedure for the isolation and crystallization of the toxin as well as its characterization will be presented at a later date.

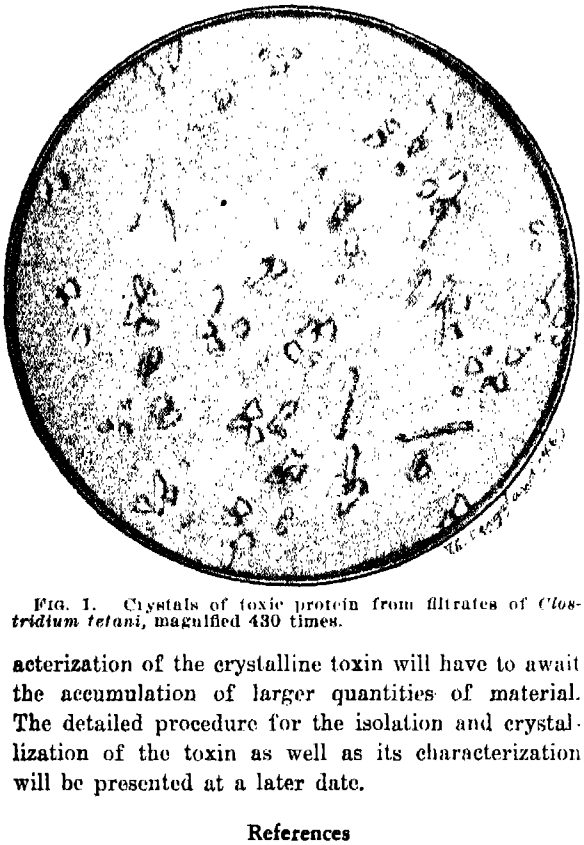


FIG. 1. Crystals of toxic protein from filtrates of *Clostridium tetani*, magnified 430 times.

References

1. EATON, M. D., and GRONAU, A. *J. Bact.*, 1938, **36**, 423.
2. MOLONEY, P. J., and HENNESSY, J. N. *Canad. Publ. Hlth J.*, 1942, **33**, 157.
3. MUELLER, J. H., and MILLER, P. A. *J. Immunol.*, 1945, **50**, 377.
4. PICKETT, M. J., HOEPRICH, P. D., and GERMAIN, R. O. *J. Bact.*, 1945, **49**, 515.
5. PILLEMER, L. *J. Immunol.*, in press.

The Effect of the Prepartum Diet of the Cow on the Vitamin A Reserves of Her Newborn Offspring[1]

G. H. WISE, M. J. CALDWELL, and J. S. HUGHES
Kansas Agricultural Experiment Station, Manhattan

The importance of the prenatal nutrition of the calf is recognized, but the problem has been given scant consideration experimentally. Analyses of livers (*1, 3, 5, 6, 7, 8, 12*) and of blood (*14, 15*) from young calves (fetuses and newborn) revealed low vitamin A reserves. The general uniformity of these results in conjunction with observations of laboratory animals has led to the belief that the gestation diet of the dam has no appreciable effect on the vitamin A content of the fetal calf liver. Recently, however, Braun and Carle (*3*) noted that the vitamin A content of the fetal calf liver, though low, was in direct relationship to the diet of the mother. Unfortunately, conclusions from many of the data are vitiated by pathological complications in the experimental subjects.

In view of the foregoing evidence, steps were taken to ascertain the effects of the plane of carotene and vitamin A intake of the dam during the latter stages of gestation on the vitamin A reserves of the normal newborn offspring.

Procedure. The experimental subjects were healthy dairy animals of the Ayrshire, Holstein, and Jersey breeds, of which the latter constituted about 50 per cent. During the immediate prepartum period, the dams were placed under three dietary regimes with respect to the carotene and vitamin A intake: standard, high carotene, and high vitamin A. All the cows were fed a basal ration consisting of good-quality alfalfa hay, sorghum silage and a concentrate mixture. Group I (the standard, or control) was restricted to this ration, but Group II (high carotene) was grazed on pasture forage in addition, and Group III (high vitamin A) was fed a vitamin A supplement.[2] The carotene intake was undetermined, but the vitamin A consumption per cow was one million U.S.P. units daily. The prepartum period of pasture grazing ranged from 14 to 90 days, and of vitamin A supplementation from 8 to 45 days.

Samples of venous blood were drawn from the calves, usually within four hours after birth and always before colostrum ingestion. The collection of blood in the early postpartum stages was necessitated by the tendency of the vitamin A concentration in the serum to decrease in the fasted newborn (*9*). Subsequently several of the calves from dams in each group were sacrificed to obtain their livers for analysis.

The general analytical procedures adopted in the determinations of carotene and vitamin A were the Kimble (*11*) for blood and a modification of the Guilbert and Hart (*6*) for liver. The major deviation in the latter case was in the use of ether extract from a sample of dry tissue (dehydrated by grinding with anhydrous sodium sulfate) for saponification.

Results. The data in Tables 1 and 2 reveal no marked differences between the vitamin A reserves of calves from cows on the basal ration and those on the high carotene but a significantly higher storage in the case of vitamin A supplementation. The results further indicate a positive relationship between the vitamin A of the blood and that of the liver. In accord with observations of other investigators carotene was usually present in the serum but undetectable in the liver.

---

[1] Contribution No. 162, Department of Dairy Husbandry, and No. 304, Department of Chemistry.

[2] "Dry vitamin A" supplied by Distillation Products, Inc., Rochester, N. Y.

TABLE 1

THE EFFECT OF THE PREPARTUM DIET OF THE DAMS ON THE VITAMIN A AND CAROTENE IN THE BLOOD SERUM OF THE NEWBORN CALVES

Group	Supplements to basal ration	No. of calves	Average values for serum	
			Vitamin A	Carotene
			γ/100 ml.	γ/100 ml.
I	None	4	2.90 ± 0.42*	0.65 ± 0.38*
II	Pasture	8	2.65 ± 0.49	1.39 ± 0.47
III	"Dry vitamin A"	4	9.40 ± 0.96	1.47 ± 0.70

* Standard error as determined by *Bessel's Formula* (*16*).

TABLE 2

THE EFFECT OF THE PREPARTUM DIET OF THE DAMS ON THE VITAMIN A AND CAROTENE IN THE LIVER OF THE NEWBORN CALVES

Group	Supplements to basal ration	No. of calves	Average values for liver	
			Vitamin A	Carotene
			γ/gram*	γ/gram
I	None	3	0.49 ± 0.19	0
II	Pasture	5	0.58 ± 0.12	0
III	"Dry vitamin A"	2	6.75 ± 1.15	0

* Wet basis.

The stage in the fetal development when vitamin A supplementation was most effective in augmenting the body reserves is undetermined, but the observations made in this study revealed no advantage for periods longer than the terminal two weeks of gestation.

Discussion. A basis for further appraisal of the magnitude of the vitamin A stores in the newborn offspring may be obtained by comparing the data presented in Tables 1 and 2 with those derived from older calves. The vitamin A concentration of 9.4γ/100 ml. of serum from the prenatally supplemented newborn was about the same as noted in the colostrum-fed calves 12 hours of age (*9, 15*) and near the lower level of the range reported to be normal for young calves (*13*), presumably beyond the colostrum ingestion stage. For the livers the average value of 6.75γ of vitamin A/gram, in the group from vitamin A-supplemented dams, was considerably greater than 2.2γ/gram found in a calf 12 hours after receiving colostrum, but markedly less than 19.5γ/gram, in a calf fed colostrum for four days (*9*). It should be emphasized, however, that the values from colostrum-fed calves are subject to wide variations, due to the variable amounts of the food ingested and to the extremes in vitamin A and carotene potency of the colostrum.

The low values for vitamin A normally found in the fetal calf liver seemingly are ample for development *in utero* but inadequate for continued postnatal health. A rapid increase of the vitamin A concentration in the newborn apparently is essential in protecting it from many calfhood disorders. The first primary source of nutrients is colostrum, the vitamin A potency of which depends on the prepartum diet of the dam (*9*) as well as on other factors. Recent studies (*9*) have revealed that parturient cows under standard feeding and managerial practices occasionally do not produce colostrum, a failure that is likely to be overlooked in the average herd. Thus it appears that prenatal supplementation is an expedient means of endowing the young calf with vitamin A and of aiding in the prevention of diarrhea in the newborn (*4*).

The effect of the prenatal diet on the vitamin A reserves of the offspring introduces the conjectural issue of placental transmission and fetal storage. From the low vitamin A values normally observed in the fetal liver two principal theories have emerged: either (1) the placenta permits only limited amounts of carotene and vitamin A to pass or (2) fetal metabolism inhibits extensive storage. Evidence gleaned from the literature indicates that the placenta plays the primary regulatory role. On this premise a *placental threshold* conceivably may serve in the control mechanism. Feeding massive amounts of vitamin A thus would increase the concentration in the maternal circulation to the extent that a portion of the excess passes into the fetus. This, however, is not in accord with the low values from the pasture-supplemented group. A more feasible explanation may be found in the recognized differential permeability of the placental membrane. Possibly the esterfied form of vitamin A, present in the fish liver oils and their distilled concentrates (*10*) and detected in the circulation of the "dry vitamin A"-supplemented cow (*9*), traverse the placenta more readily than the alcohol form which is suggested (*2*) as the principal form normally present in the circulation of the bovine.

The stability of vitamin A is another factor that perhaps plays a role in storage as well as in transmission. The ester form may be resistant to destructive processes in the placenta and to metabolic activity in the fetus. If this were true, however, the problem of utilization probably would tend to nullify the value of the reserves.

Factors involved in the prenatal nutrition of the bovine fetus are being explored further with the view of overcoming some of the difficulties to which the newborn calf is subject.

Summary. Feeding vitamin A at the rate of a million U.S.P. units daily to individual dairy cows in the latter stages of gestation augmented significantly the vitamin A concentration in the blood and the livers of their newborn calves, but pasture grazing, providing an abundance of carotene in the prepartum diet of the dams, failed to effect an increase over that observed in calves from dams restricted to a standard winter ration. The explanation for these divergent results is obscure, but it is suggested that the placental membrane may be more permeable to the ester form of vitamin A than to the alcohol form. This high initial vitamin A reserve in the newborn calf should have practical value in the maintenance of its postnatal health.

References

1. Barron, N. S. *Vet. Rec.*, 1942, **54**, 29.
2. Boyer, P. D., Phillips, P. H., and Smith, J. K. *J. biol. Chem.*, 1944, **152**, 445.
3. Braun, W., and Carle, B. N. *J. Nutrition*, 1943, **26**, 549.
4. Bruce, R. H. *N. Amer. Vet.*, 1945, **26**, 602.
5. Dann, J. W. *Biochem. J.*, 1933, **27**, 1998.
6. Guilbert, H. R., and Hart, G. H. *J. Nutrition*, 1934, **8**, 25.
7. Hart, G. H., and Guilbert, H. R. *Calif. Agric. exp. Sta. Bull.*, 1933, **560**, 16.
8. Hart, G. H., and Guilbert, H. R. *Amer. J. vet. Res.*, 1941, **2**, 390.
9. Kansas Agricultural Experiment Station. Unpublished data, 1945.
10. Kascher, H. M., and Baxter, J. G. *Ind. eng. Chem.* (Anal. ed.), 1945, **17**, 499.
11. Kimble, M. S. *J. lab. clin. Med.*, 1939, **24**, 1055.
12. Krauss, W. E. Private communication, 1945.
13. Loosli, J. K., Huffman, C. F., Petersen, W. E., and Phillips, P. H. *Recommended nutrient allowances for dairy cattle.* (Rep. No. 3.) Washington, D. C.: National Research Council, 1945.
14. Lundquist, N. S., and Phillips, P. H. *J. dairy Sci.*, 1943, **26**, 1023.
15. Moore, L. A., and Berry, M. H. *J. dairy Sci.*, 1944, **27**, 867.
16. Snedecor, G. W. *Statistical methods.* (1st ed.) Ames, Iowa: Collegiate Press, 1938. Pp. 50, 69.

The Low Therapeutic Activity of Penicillin K Relative to That of Penicillins F, G, and X, and Its Pharmacological Basis

Harry Eagle and Arlyne Musselman

The Johns Hopkins University and U. S. Public Health Service Venereal Disease Research Laboratory and Postgraduate Training Center, Baltimore, Maryland

Commercial penicillin contains at least four molecular species, identified as F, G, K, and X and differing from each other in the nature of the side group attached to a common nuclear structure (*8*). These are known to vary significantly in their bactericidal activity *in vitro*. Thus, referred to penicillin G as 100, the relative activities per milligram of penicillins F, G, K, and X against *Staphylococcus aureus* are reported to be 90, 100, 140, and 55, respectively (1,550, 1,667, 2,300, and 900 units/mg.) (*7*). In this laboratory, crystalline samples of F, G, K, and X were found to have relative gravimetric activities *in vitro* of 82, 100, 120, and 140 against the C-203 strain of hemolytic streptococcus, and 53, 100, 75, and 50, respectively, against a cultured strain of *Spirochaeta pallida* (Reiter) (*3*).

Subsequently, however, results obtained in the treatment of experimental syphilis indicated differences in the relative activity of the several penicillins *in vivo* far exceeding those hitherto observed *in vitro*. The curative dose (CD_{50}) of commercial penicillins, which probably consisted largely of penicillin G, had been found by Eagle, Magnuson, and Fleischman (*2*) to be 1,650 units/kg. when given every four hours for 20 injections. Almost identical results were obtained by Fleming (*4*), using both commercial penicillin and crystalline G. However, with penicillin K similarly administered preliminary data provided by Chesney (*1*) and confirmed by Mahoney and Arnold (*5*) indicated that even 16,000 units/kg. were not curative.

The obvious explanation for this marked discrepancy between the activities of penicillins G and K seemed to be that penicillin K, despite its definite activity against cultured, nonpathogenic spirochetes, was relatively inactive against pathogenic *S. pallida*. An alternative, if less likely, explanation was that penicillin K might be excreted or destroyed in the body more rapidly than the other penicillins and would therefore be relatively ineffective not only in the treatment of syphilis but in other infections as well. The data here presented indicate that this is in fact the case. Penicillin K disappears from the blood, and presumably the tissue fluids as well, far more rapidly than do the other penicillins; and the relatively small amount excreted in the urine suggests that it is inactivated *in vivo* to a greater degree than penicillins F, G, or X. Finally, corresponding to its pharmacologic behavior, and in complete agreement with the results in experimental syphilis (*5, 9*), it has proved approximately 9 to 15 per cent as active as penicillins F, G, or X in the treatment of experimental pneumococcus or streptococcus infections in white mice.

Preliminary data indicate that the rapid disappearance of penicillin K from rabbit blood and its relatively low recovery in the urine are due to its inactivation by the circulating blood. In rabbits the inactivating agent appears to be a relatively thermolabile, nondialyzable constituent of plasma. It is not present in any of the highly purified protein fractions of human plasma so far tested.

Blood levels and urinary excretion in rabbits. When rabbits were injected intramuscularly with crystalline penicillins F, G, K, and X[1] at equivalent dosage (0.6 mg./kg.), essentially similar blood levels were obtained with F, G, and X.

---

[1] The following firms have made available samples of crystalline penicillin used in this study: Upjohn (F), Squibb (G), Lederle (X), and Abbott (K). Their cooperation is gratefully acknowledged.

With penicillin K, on the other hand, the blood level fell far more precipitously than with the other three. Thus, one hour after the injection, the blood level in 7 animals injected with K ranged between a minimum of < 0.02 and a maximum of 0.031 µg./cc., averaging approximately 0.02; while in 10 animals receiving the other three penicillins, the blood levels at one hour varied between 0.07 and 0.45 µg./cc., averaging 0.23, or 11 times the average level of K. The length of time for which penicillin remained at a measurable level, e.g. 0.04 µg./cc., averaged 45 minutes with penicillin K, and two hours with the other three penicillins.

The data on the urinary excretion of penicillin in rabbits showed equally pronounced differences between penicillin K, on the one hand, and the other three penicillins on the other. The total cumulative excretion over a period of six hours in six rabbits receiving K varied between 18 and 42 per cent of the total injected and averaged 33 per cent; while in nine rabbits receiving penicillins F, G, and X the corresponding cumulative excretion varied between 39 and 100 per cent and averaged 74 per cent.

Blood levels and urinary excretion in man. Results qualitatively similar to those in rabbits were obtained in six men injected with identical doses of F, G, K, and X (0.6 mg./kg.). With penicillin K, the blood penicillin level one hour after injection varied between < 0.036 and 0.14 µg./cc., averaging 0.08; the corresponding values in the same four patients similarly injected with G were 0.14 to 0.57, with an average of 0.31 µg./cc. In man, the length of time for which the blood contained measurable amounts of penicillin, e.g. 0.04 µg./cc., averaged approximately 70 minutes in the case of penicillin K and was more than two hours with penicillin G.

The differences in the urinary excretion of G and K in man were consistent and marked. In four patients injected with 0.6 mg./kg. of penicillin G, the cumulative percentages excreted in the urine in six hours were 95, 99, 73, and 99, the average being 91 per cent. When the same four patients were injected with an equal amount of K, the corresponding percentages recovered in the urine in six hours were 39, 31, 31, and 22, the average being 31 per cent.

Therapeutic activity of penicillins F, G, K, and X in experimental infections in white mice. One would anticipate from the foregoing data that penicillin K would be relatively inactive *in vivo* in any infection, and regardless of its bactericidal activity *in vitro*. To determine this point, mice heavily infected with pneumococcus Type I and with *Streptococcus pyogenes* were treated with varying doses of penicillins F, G, K, and X. The curative doses (CD_{50}) of penicillins F, G, K, and X in pneumococcus Type I infection were, by the particular method of treatment used, totals of 4, 3.4, 20, and 2.45 mg./kg., respectively. Expressed relative to G as 100, these are gravimetric activities of 85, 100, 17, and 140. Penicillin K was thus one-sixth as active per milligram as penicillin G and one-eighth as active as penicillin K. The sample of penicillin K used in this experiment contained up to 10 per cent of some contaminating penicillin other than K. It follows that the therapeutic activity of pure K would have been even less than that observed.

An even more striking difference between the activity of K and the other three penicillins was observed in the treatment of streptococcal infections in mice. Against that same strain of streptococcus the relative activities of crytsalline F, G, K, and X *in vitro* had been found to be 82, 100, 120, and 140, respectively. Their curative doses (CD_{50}) in infected mice were 2.6, 1.3, 14.9, and 0.5 mg./kg., or relative activities of 50, 100, 9, and 260. Penicillin K was therefore only one-eleventh as active as penicillin G and one-thirtieth as active as penicillin X *in vivo,* despite its high activity against the same organism *in vitro.*

Practical implications. The strain of penicillium most widely used at the present time in the commercial production of penicillin is the Q-176 strain of *Penicillium chrysogenum.* It is stated that up to 50 per cent of the penicillins produced by this strain in the absence of specific precursor substances may be penicillin K. The present data indicate that, with "penicillin" containing such large amounts of K, the actual therapeutic potency *in vivo* may be far less than its activity *in vitro,* measured in staphylococcidal units. With such penicillins, previously effective doses may be therapeutically inadequate, and larger amounts must be administered to achieve the same results.

It is clearly desirable to modify the method of producing penicillin in order to minimize the proportion of K in the final product. If a single molecular species of penicillin cannot be provided, whether F, G, or X, it would be desirable also to use methods of standardization which bear a more direct relationship to therapeutic activity than does the determination of bactericidal activity *in vitro.* The determination in experimental animals of either therapeutic activity or residual blood penicillin, e.g. one hour after the injection of a standard test dose, might suffice for this purpose.

SUMMARY

One hour after the injection into rabbits or man of penicillins F, G, K, and X at 0.6 mg./kg., blood

levels of K were one-fourth to one-eleventh of those observed with the other penicillins, and K persisted at demonstrable levels for relatively short periods.

In both rabbits and man the recovery of K in the urine averaged 30–35 per cent. This compares with an average recovery for F, G, and X of 74 per cent in rabbits and 91 per cent in man.

In the treatment of experimental pneumococcal infections in white mice, an impure preparation of K was one-sixth as active as G and one-eighth as active as X. In the treatment of experimental streptococcal infections in white mice, a pure preparation of K was one-eleventh as active as G, and one-thirtieth as active as X.

The above data suggest that penicillin K is inactivated in the body to a greater extent and more rapidly than either F, G, or X, resulting in a far lower therapeutic activity than would be anticipated from its bactericidal action *in vitro*. It seems clear that the amount of K in commercial penicillin should be minimized; and it would seem desirable to standardize impure mixtures of penicillins for therapeutic use by some method other than their bactericidal activity *in vitro*.

References

1. CHESNEY, A. M. Personal communication.
2. EAGLE, H., MAGNUSON, H. J., and FLEISCHMAN, R. *Bull. Johns Hopk. Hosp.*, in press.
3. EAGLE, H., and MUSSELMAN, A. *J. Bact.*, in press.
4. FLEMING, W. Personal communication.
5. MAHONEY, J. F., and ARNOLD, R. C. Personal communication.
6. RAMMELKAMP, C. H. *Proc. Soc. Biol. exp. Med.*, 1942, **51**, 95.
7. VELDEE, M. V., HERWICK, R. P., and COGHILL, R. D. *Science*, 1945, **101**, 42; WELCH, H., PUTNAM, L. E., RANDALL, W. A., and HERWICK, R. P. *J. Amer. med. Ass.*, 1944, **126**, 1024; LIBBY, R. L., and HOLMBERG, N. L. *Science*, 1945, **102**, 303; COGHILL, R. D. Personal communication.
8. ———. Chemistry of penicillin. *Science*, 1945, **102**, 627.

Direct Culture of Rheumatic Virus[1]

WARD J. MAC NEAL, KATHERINE WARDELL, ANNE BLEVINS, and MARCELLO R. PACIS

Department of Bacteriology, New York Post-Graduate Medical School and Hospital, Columbia University

In March 1945 there was presented before the New York Pathological Society (*4*) a demonstration of specimens and a discussion concerning the production of nonbacterial endocarditis of a verrucous type in experimental animals following the injection of pericardial fluid, whole blood, and blood plasma from patients with rheumatic fever, and the subsequent propagation of the supposed pathogenic agent or agents in embryonated eggs and transfer back to the small mammals to reproduce the disease. It was recognized that virus diseases naturally present in the experimental animals may give rise to difficulty in interpretation of the morphological results, as had been noted by De Vecchi (*3*) and Andrei and Ravenna (*1*); hence the need of supporting evidence.

J. L., girl aged 16, with severe rheumatic endocarditis and pericarditis and temperature of 105.2°, was admitted to hospital on 12 January 1946. The plasma of her blood, drawn that evening, was injected into five embryonated eggs on 13 January. Of these eggs, two died on the first day, one on the fourth day, and two were killed on the sixth day, so that the result was briefly recorded as $D_1 - D_1 - D_4 - K_6 - K_6$. Another specimen of plasma, taken on the morning of 13 January and injected into five eggs on this day, gave the result $D_1 - K_6 - K_6 - K_6 - K_6$; and the third specimen, taken on the afternoon of 13 January and injected without delay into five eggs, gave the result $D_2 - D_2 - K_6 - K_6 - K_6$. On 14 January a fourth specimen, taken in the morning, supplied plasma for five eggs with the result $D_1 - D_3 - K_6 - K_6 - K_6$. A fifth specimen, taken that afternoon, supplied plasma for five more eggs and resulted in $D_2 - D_3 - D_3 - K_6 - K_6$.

None of these eggs showed any recognized pathological changes. The extraembryonic fluids were harvested promptly and found bacteria free by aerobic culture.

On 21 January the pooled fluids from these 25 eggs were used in part for the inoculation of rabbits and guinea pigs and later for inoculation of more embryonated eggs (see below).

Meanwhile, on 15 January some of the citrated plasma saved from the blood drawn on 12 January was used for inoculation of the chorioallantoic membranes of five embryonated eggs, aged 9 days. All five of these eggs survived to be harvested on 18 January ($K_3 - K_3 - K_3 - K_3 - K_3$), and all exhibited remarkable localized thickening of the chorioallantoic membrane and intense reddish-pink discoloration of the embryo proper. Aerobic bacterial cultures remained free from growth. One membrane of this lot was ground in a mortar and suspended in saline solution for inoculation on the chorioallantois of five additional embryonated eggs on 29 January. All these survived to be harvested on 2 February ($K_4 - K_4 - K_4 - K_4 - K_4$), and each exhibited a thickened chorioallantoic membrane with local nodules and general reddening of the live embryo itself.

The pooled fluids of the first 25 eggs mentioned above (21 January) were used in part for injection into five eggs on 26 January, with the result $D_2 - D_2 - D_4 - K_6 - K_6$. No pathological changes were recognized in these eggs. On 26 January, also, this

---

[1] Aided in part by Grants No. 522 and No. 523 of the Committee on Therapeutic Research, Council on Pharmacy and Chemistry, American Medical Association; and by the Virus Research Fund of the Lambert Pharmacal Company.

same pooled fluid was used to inoculate the chorioallantoic membrane of five embryonated eggs. The result was $K_3 - K_3 - K_3 - K_3 - K_3$. All these eggs exhibited thickened membrane and reddened embryo at harvest on 29 January. One of these membranes was ground and suspended in saline solution for inoculation onto chorioallantois of each of five embryonated eggs on 1 February the result being $K_4 - K_4 - K_4 - K_4 - K_4$. All five had thick lesions on the chorioallantois and reddened embryo at harvest.

A further specimen of blood, drawn from the patient on 24 January, supplied plasma for egg inoculations on 26 January. This was injected into five eggs, with the result $D_2 - D_3 - D_4 - K_6 - K_6$. One of these, dying on the fourth day, exhibited a much thickened chorioallantois. The others were free from recognized gross alterations. Also on 24 January this same plasma was used to inoculate the chorioallantois in each of five eggs, with the result $K_3 - K_3 - K_3 - K_3 - K_3$. Each of these eggs at harvest exhibited locally thickened membrane and diffuse redness of the embryo.

The pooled extraembryonic fluid from the first 25 eggs was used in part for intravenous injection into rabbits and intraperitoneal injection into guinea pigs. This experiment is to be reported elsewhere.

The brief title of this note should not be misinterpreted. Rheumatism is a clinical term which has been applied to diseases of diverse causation. Patient J. L. is suffering from a severe first attack of the rheumatic fever of adolescence with evidence of endocardial and pericardial inflammation, a disease entity recognized more or less definitely since the classical description of Bouillaud (*2*). The observations reported here indicate that the blood of this patient has harbored an agent which has been propagated in embryonated eggs with the production of rather characteristic changes in the eggs.

References

1. ANDREI, GUISEPPE, and RAVENNA, PAOLA. *Arch. int. Med.*, 1938, **62**, 377–387.
2. BOUILLAUD, J: *New researches on articular rheumatism.* (Trans. by James Kitchen.) Philadelphia: Haswell, Barrington, and Haswell, 1837. Pp. iv + 56; *Traité clinique du rheumatisme articulaire et de la loi de coincidence des inflammations du coeur avec cette maladie.* Paris: J. B. Baillière, 1840. Pp. xxx + 554.
3. DE VECCHI, BINDO. *Arch. Méd. exp. Anat. Pathol.*, 1912, **24**, 352–420.
4. MAC NEAL, WARD J., BLEVINS, ANNE, SLAVKIN, ALICE E., and SCANLON, HELEN. *Science*, 1945, **101**, 415–416; *N. Y. St. J. Med.*, 1945, **45**, 1440–1441.

News and Notes

Editorial Announcement

Next week *Science* will consist of only 32 pages. This reduction in size is forced on us simply because we do not have the paper for the larger journal our readers have come to expect.

Paper supplies, which were scarce enough during the war period, have become even more scanty since controls on consumption were removed.

Strikes in the various industries and services have further added to the acuteness of the scarcity, which is prevalent in all kinds of paper, kraft, newsprint, book, and coated stocks. If it were possible to bring you *Science* printed on wrapping paper, we would do it!

We hope that the emergency will last only a few weeks, but actually at this time, there is no sure way of predicting how long it will last.

Some monthly scientific publications will not be able to print their June issues at the regular time and whether these numbers will appear in July or in August, no one is able to say at the moment.

Ernest W. Goodpasture, professor of pathology and dean of the School of Medicine, Vanderbilt University, Nashville, Tennessee, has been selected as the 1946 recipient of the Passano Foundation Award, according to the Board of Directors of the Foundation. Presentation of the $5,000 cash award was made at an appropriate ceremony in Osler Hall of the Medical and Chirurgical Faculty of Maryland, in Baltimore, on the night of 15 May, when Dr. Goodpasture will speak on "Research and Medical Practice."

The Foundation, which was established in 1944 by the Williams and Wilkins Company, Medical Publishers, of Baltimore, proposes to aid in any way possible the advancement of medical research, especially research that bears promise of clinical application. For the encouragement of such research the Foundation has established the award as one of its activities.

Dr. Goodpasture receives the award for his original development of the method for propagation of viruses in pure culture by inoculation of chick embryos and for his outstanding contributions to advancement of knowledge of the cell-parasite relationship in bacterial and virus infection.

Albert E. Wood, paleontologist, has been appointed assistant professor of biology at Amherst College, effective 15 April 1946. Dr. Wood had been a geologist with the U. S. Army Flood Control prior to entering the Army in 1942.

Felix Ehrenhaft, physicist, of New York, has been asked to resume his former position as professor at the University of Vienna. This invitation, sent by the Austrian Minister of Education, was forwarded through the Chief of the Education Branch, U. S. Forces in Austria. The letter emphasized that the rights of Austrian professors, who had been dismissed by the Nazis, will be recognized by the present Austrian Government.

Maj. Merrill Moore, Medical Corps, has returned to the United States for a brief tour of duty after three years in the South Pacific and has been reassigned to foreign service as surgeon to the Nanking Headquarters Command. His address is APO 909, Postmaster, San Francisco, California.

A. V. Hill, London, *L. Lapicque*, Paris, and *L. A. Orbeli*, Moscow, have been made honorary members of the American Physiological Society.

H. Munro Fox, F.R.S., chairman of the British National Committee for Biology, left England on 27 March to make a tour of Europe in order to discuss with colleagues on the Continent cooperation in biological science and particularly the future of the International Union for Biology.

Philip W. West will leave in the middle of May to study with Dr. Fritz Feigl in Rio de Janeiro, Brazil. Dr. West will return this fall to resume his duties as head of the Division of Analytical Chemistry at Louisiana State University. During his stay in Rio de Janeiro he will collaborate on researches in Spot Test Analysis. The work will be conducted in the Laboratories of Mineral Productions of the Brazilian Ministry of Agriculture.

Bart J. Bok, of the Harvard Observatory, gave the address following the annual initiation exercises of the Smith College Chapter of Sigma Xi on 10 April. His subject was: "Between the Stars."

Col. Francis R. Dieuaide, recently chief of the Tropical Disease Treatment Branch of the Surgeon General's Office, has been named scientific director of the Life Insurance Medical Research Fund as of 1 April, with offices at 333 Cedar Street, New Haven 11, Connecticut.

The Life Insurance Medical Research Fund was established in 1945 to make grants to universities and medical schools for research on diseases of the heart and related diseases. The Fund plans to make grants of more than $3,000,000 for this purpose over the next five years. A total of 147 life insurance companies in this country and Canada are supporting the Fund.

Coincident with the announcement of Dr. Dieuaide's appointment, M. Albert Linton, chairman of the Fund, announced that the directors had approved a new series of grants totaling $310,000 in support of research work on diseases of the heart and related diseases at 27 institutions in this country and in Canada. This action brings the total of grants made since the Fund was organized to $436,000. Other applications are still under consideration. As scientific director, Dr. Dieuaide will investigate the applications for funds and make recommendations to the group's advisory council.

Isabelo Concepcion has written from the Philippines to Carey D. Miller, of the University of Hawaii Agricultural Experiment Station, Honolulu, as follows:

> As you probably know, Manila is now a ghost city. There are no laboratories or libraries that have survived the destruction of the city. That is the reason why I am so far behind in nutrition literature, and I shall appreciate it very much if you can send me reprints of your work during the past five years and any other literature that will help me in my studies on nutrition and particularly references on the vitamin content of foods, especially on tropical foods.
>
> At present I am studying the adequacy of the food intake of our wage earners and also the incidence of dental fluorosis in the Islands. I am very much interested in the subject of biomicroscopy and its use in the early diagnosis of deficiency diseases.

Dr. Concepcion is now professor of biochemistry in the College of Medice, University of Santo Tomas. His address is: 589 Zamora, Pasay; Rizal, Philippines, where he would like to receive reprints and books.

Carl Gustaf Rossby, of the University of Chicago, internationally famous meteorologist of Swedish birth, will serve as an expert at the newly founded Swedish Government Meteorological-Hydrographical Institute in Stockholm.

Edwin B. Wilson is returning to the United States from Glasgow. He was in residence at the University there from 1 October 1945 to 30 March 1946 to give the Stevenson Lectures on Citizenship.

Jack A. Gerster has accepted the position of assistant professor of chemical engineering at the University of Delaware. He was previously connected with the Du Pont Company and spent a large part of 1944 and 1945 on the Manhattan Project.

Laurence H. Snyder, of the Ohio State University, addressed the Syracuse University Chapter of Sigma Xi on 19 April on the topic: "Human Heredity and Modern Life."

John A. Fleming, director of the Department of Terrestrial Magnetism of the Carnegie Institution of

Washington, was elected a member of the Norwegian Academy of Sciences and Letters in its Section of Mathematics and Natural Science on 22 March.

Allyn C. Swinnerton, professor of geology at Antioch College, has been awarded the Legion of Merit by the War Department. His principal work while serving in the Signal Corps was in research and development relating to quartz crystals.

Francis G. Gilchrist, of Riverside College, Riverside, California, has been appointed chairman and head of the Department of Biology at Lewis and Clark College, Portland, Oregon. He will succeed Florence Peebles, who retires this year.

Mont A. Casier has returned to the American Museum of Natural History, New York City, as chairman and associate curator of the Department of Insects and Spiders.

Robert N. Feinstein has joined the staff of the May Institute for Medical Research, Cincinnati, after four years in the Army. He will be in charge of the biochemical aspects of research at the Institute.

Louis Jordan has been appointed executive secretary of the Division of Engineering and Industrial Research of the National Research Council. Mr. Jordan, trained initially as a chemist and metallurgist, was for many years a member of the staff of the metallurgical division of the National Bureau of Standards, directing research in chemical metallurgy and in heat treatment and elevated temperature service of metals. In January 1942 he went to the National Research Council and was responsible throughout World War II for the administrative organization and operation of the War Metallurgy Committee in all of its activities as an advisory committee to OSRD and WPB in the fields of minerals and metals research and development.

Lise Meitner, pioneer atomic scientist now teaching nuclear physics at Catholic University, Washington, D. C., has been elected to the Academy of Sciences of Oslo, Norway, the University announced recently. Dr. Meitner is on a month's lecture tour of colleges throughout the country. Her first lecture was in Cambridge, Massachusetts, before the American Physical Society on 25 April.

Henry Eyring, professor of physical chemistry at Princeton University since 1933, has been named dean of the Graduate School of the University of Utah. In addition to his academic duties at Princeton, Dr. Eyring has been director of technical research instituted at that University. Dr. Eyring is secretary of the Physical and Inorganic Section of the American Chemical Society, vice-president of the AAAS, and chairman of Section C. In 1933 Dr. Eyring won the $1,000 AAAS award given for the best scientific paper of the year.

The Graduate School was created by the University of Utah Board of Regents to replace the Graduate Division, which has been administered by a faculty committee headed by Orin Tugman, head of the Physics Department. Dr. Tugman is retiring from the University faculty.

Charles D. Michener has returned to the American Museum of Natural History, New York City, as associate curator in the Department of Insects and Spiders.

Col. Richard P. Strong was awarded the Legion of Merit on 10 April. As director of Tropical Medicine, Army Medical School, he supervised and participated in the instruction of nearly 2,000 students, including medical officers of five Allied Governments and staff members of American medical colleges.

Tibor Rado will become chairman of the Department of Mathematics at Ohio State University, succeeding John L. Synge, who has resigned, effective 30 September, to head the Applied Mathematics Division of Carnegie Institute of Technology, Pittsburgh.

Robert L. Usinger has resumed his work at the University of California as assistant professor of entomology and assistant entomologist in the Experiment Station, with headquarters on the Berkeley campus. He was released from duty in Malaria Control, U. S. Public Health Service, on 30 April.

Col. George W. Hervey, on duty in the Office of the Chief of Staff, War Department, since October 1944 and previously attached to Headquarters, Army Service Forces, will go on inactive status on 13 June and join the administrative staff of the Surgeon General of the Army in a civilian capacity.

Announcements

The program in Agricultural Science, established at Yale University three years ago but delayed in its development because of the war, will be open to students at the beginning of the next academic year. This program is designed to provide training in the sciences fundamental to agriculture for men planning to enter professional work in this field. The increasing importance of food production in a hungry world and the many technical problems which modern agriculture faces have resulted in a wide demand today for workers with a broad background of scientific training to serve in experiment stations, industrial laboratories, commercial organizations, and other agencies. Such training most men now seek in colleges of agriculture, but other institutions where adequate staff and facilities are available may well offer additional opportunities for work of this sort. Yale is particularly well situated to undertake such a program. The first appointment in what later became the Sheffield Scientific School was that of a professor of agricultural chemistry, and from work thus begun developed the first agricultural experiment station in the country. Yale itself served for some years as a land-grant college.

The curriculum being offered is one of several open to students who elect to major in the biological sciences. It includes work in English and a modern language and offers opportunity in each year for one nonscience elective. In the sciences, basic courses in botany, zoology, chemistry, physics, mathematics, physiology, nutrition, genetics, and soil science are required. In the last two years opportunity is offered for election among a considerable group of courses more closely related to agriculture, including entomology, mycology, plant pathology, economic zoology, parasitology, microbiology, plant and animal improvement, economic botany, plant ecology, agricultural economics, geography, and biometry. These courses will be given by men from various departments of the University, including the Schools of Forestry and Medicine.

No work in the practical or educational aspects of agriculture is proposed, nor is there any attempt to compete in this field with the agricultural colleges. It has been felt that for most students who are going into the agricultural professions, a grounding in the basic sciences is the most important training to obtain during their undergraduate years. Where more technical knowledge of agricultural materials and practices is needed, this can be gained either in graduate work or by direct experience in the laboratory or field. It is hoped that the proposed program will encourage men of high ability and scientific interests to enter a professional career which needs such men but which has not heretofore attracted many students in nonagricultural institutions.—*Edmund W. Sinnott* (Yale University).

A new foundation, The Medical Memorial Fund, has been organized to accept gifts from the public and to distribute its income to the various medical schools and research institutions. It receives its income largely from memorial gifts from the public. As each memorial gift is received, a dignified "Memorial Certificate" is sent to the bereaved family to notify them of the gift. All gifts, whether $5.00 or $5,000, are placed in a general fund to be distributed for research to various medical schools and research laboratories.

The officers of the Fund are: Harlow Shapley, Ph.D., chairman; Henry S. Simms, Ph.D., president; Russell L. Cecil, M.D., vice-president; J. Murray Steele, M.D., vice-president; Marvin R. Thompson, Ph.D., secretary; Guy Emerson, treasurer; J. Murray Steele, M.D., medical director; and John V. Duncan, counsel.

Distribution is determined by a scientific committee aided by various subcommittees and special consultants. A total of about 50 medical scientists cooperate in making decisions concerning the disbursal of grants. Members of the Scientific Committee include: J. Murray Steele, M.D., chairman; A. J. Carlson, Ph.D.; Russell L. Cecil, M.D.; Harry Goldblatt, M.D.; Theodore G. Klumpp, M.D.; Chauncey D. Leake, Ph.D.; William deB. MacNider, M.D.; Marvin R. Thompson, Ph.D.; Henry S. Simms, Ph.D.; D. D. van Slyke, Ph.D.; A. Ashley Weech, M.D.; and George H. Whipple, M.D.

It is estimated that $5,000,000 to $10,000,000 per year could be profitably added to the support of medical research at this time. Medical Memorial Fund is conducting a campaign to raise as much of this as possible. Gifts can be made at any time throughout the year. All scientists and physicians of the country who are interested in an expansion of the medical research program, which will permit greater attention to the cardiovascular-renal diseases, to aging, and to arthritis and rheumatism, should aid the Fund not only by personal gifts but also by advising their friends and patients to make contributions.

Gifts and requests for information should be addressed to: Medical Memorial Fund, 650 West 165th Street, New York 32, New York.

Additional information on prewar and wartime production of synthetic emulsifying agents, wetting agents, detergents, and soap substitutes by the I. G. Farbenindustrie plant at Hoechst, Germany, is now available to the public, according to the Office of the Publication Board, Department of Commerce.

Data on the German developments, gathered by the Combined Intelligence Objectives Subcommittee, are contained in a 38-page report, PB–6684, available from OPB on order (photostat, $3.00; microfilm, $.50). The report is one of several on the same subject on sale by OPB.

The chief organic detergents and emulsifying agents made at the Hoechst plant before the war were "Igepons," derived from oleic acid or substitute materials, and "Igepals," based on ethylene oxide, which was produced from acetylene generated from calcium carbide. "Igepons" were used as leather assistants, washing and softening agents, and detergents. "Igepals" were used as industrial soap substitutes, for washing and soaping vegetable fibers, as dyeing assistants, detergents for wool, emulsion breakers for the petroleum industry, textile lubricating oils, and for other purposes.

Of the two types, the "Igepals" were considered superior for use with hard water. The "Igepals" allegedly were superior also to soap in this respect.

Wartime developments included detergents of the alkyl-aryl-sulfonate type and emulsifying agents and detergents from Fischer-Tropsch oils.

"Emulphor STH" and "Emulphor STX," derived from "Mersol," made from by-products of the Fischer-Tropsch synthesis of hydrocarbons from coal, proved valuable for drawing of metals. The Germans claimed that their use eliminated some of the intermediate heat-treating operations and, in many cases, the Parkerizing process employed in metal working.

PB-6684 contains details on types of emulsifiers, wetting agents, and detergents produced, raw materials used, and methods of manufacture.

Mail orders for the report should be accompanied by check or money order, payable to the Treasurer of the United States, and should be addressed to the Office of the Publication Board, Department of Commerce, Washington 25, D. C.

Eli Lilly, president of Eli Lilly and Company, has announced the purchase of government-owned facilities and the Stokely Foods buildings, at West Morris Street and Kentucky Avenue, Indianapolis, Indiana. These were formerly used by the Curtiss-Wright Propeller Division. These buildings, to be known as the Kentucky Avenue Plant of Eli Lilly and Company, cover some 26 acres and include a five-story reinforced concrete manufacturing building, two one-story manufacturing buildings, two office buildings, and two power plants conveniently near facilities of the Belt Railroad. The combined plants will give Eli Lilly and Company an additional 1,000,000 square feet of usable floor space.

The Department of Geology at Syracuse University is joining with Cornell College, Iowa, in conducting summer field courses at Camp Norton in the Wind River Mountains of Wyoming. The field camp has been operated by Neil A. Miner, director, since 1940, but this is the first year that Syracuse University has been a joint sponsor. Dr. Miner continues as director, with the staff consisting of Earl T. Apfel, David M. Delo, and Robert O. Bloomer.

Several field courses in geology are offered, including an elementary course in field methods involving the preparation of a geologic map and a comprehensive report on a selected area. A second course, designated "Field Problems in Geology," is open only to those who have had a field course in geology or its equivalent in practical field work. Field research may also be carried on either for the preparation of a thesis or for purposes of publication. There are two camp sessions, 1–28 July and 1–28 August, respectively. Students may register for either or both terms.

Camp Norton is located about 17 miles northwest of Dubois and 94 miles northwest of Lander, Wyoming. Additional information may be secured by writing Dr. Neil A. Miner, Director, Cornell College, Mount Vernon, Iowa, *or* The Department of Geology, Syracuse University, Syracuse 10, New York.

The Virginia Polytechnic Institute Chapter of the Society of Sigma Xi, at a meeting held 16 April, initiated two projects designed to encourage research at the institution. The first of these was the setting up of a research prize consisting of the V.P.I. Sigma Xi Gold Medal, to be awarded each year for the best piece of research produced by a member of the staff or a graduate student in any of the fields recognized by the Society. The recipient of the prize will be selected by a committee from an outside institution.

The second project initiated was the establishment of a series of research seminars for the Chapter members and invited guests, at which will be presented and discussed the current researches on the campus.

The Ohio Academy of Science met at Ohio State University on 3–4 May for its first meeting since the close of the war. Last year's event was canceled because of travel restrictions. The annual dinner was held on Friday, 3 May, in the Faculty Club, where the group heard the presidential address of J. Ernest Carman, of the Department of Geology at Ohio State.

Research personnel in industry and college teachers are invited to attend a graduate conference at the Agricultural and Mechanical College of Texas, devoted to the behavior of mass spectrometers, electron microscopes, and other electronic devices whose operation depends on the action of electron or ion beams. The lecturers for the conference will be Ladislaw Marton, of the Division of Electron Optics of Stanford University, formerly with the Radio Corporation of America, and John A. Hipple, of the Westinghouse Research Laboratories, in charge of the development of the Westinghouse Mass Spectrometers.

The conference will be conducted by the Electrical Engineering and Physics Departments of A. & M. College for a period of three weeks. Dr. Marton will lecture from Monday, 24 June, through Saturday, 6 July. Dr. Hipple will commence his lectures Monday, 1 July, and will conclude them Saturday, 13 July. During the second week of the conference both Dr. Marton and Dr. Hipple will be lecturing. While it is expected that the entire three weeks of the conference will provide a somewhat unified treatment of the more recent advances in the whole field of electron and ion ballistics, individuals are welcome to attend the conference for shorter periods of time. Persons primarily interested in electron optical theory, but not especially interested in mass spectrometry, could profitably attend only the first and second weeks of the conference, while those primarily interested in problems connected with the operation of mass spectrometers could enter the conference the second week and remain through the third week. The conference coincides with the last half of the first summer term of the College, enabling anyone wishing to remain to carry a full load in the regular program of the second term commencing 15 July.

A matriculation fee of $8.00 will be charged for the course, and a medical fee of $1.50 for the period will also be collected.

Persons desiring further information on the conference or accommodations are invited to write J. G. Potter, head of the Department of Physics, or M. C. Hughes, head of the Department of Electrical Engineering, Agricultural and Mechanical College of Texas, College Station, Texas. (College Station may be reached on the Southern Pacific or Missouri Pacific Railroads via Dallas or Houston.)

Grants up to $10,000 a year for five years to aid research in agricultural chemistry are being offered to universities and other nonprofit research institutions throughout the country by the Herman Frasch Foundation for Chemical Research, it is announced by the United States Trust Company of New York, trustee of the Foundation.

Recipients of the grants, which will be made for the five-year period beginning 1 January 1947, will be chosen by the trustee with the advice of the American Chemical Society. The amount allotted in each instance will depend on the nature of the project concerned.

Designed to stimulate research which will be of practical benefit to the agricultural development of the United States, the grants are made every five years from a trust fund set up under the will of Elizabeth Blee Frasch in memory of her husband, Herman Frasch, chemist, who invented the process of mining sulphur by steam and who was for many years president of the Union Sulphur Company.

Applications for grants must be submitted before 1 July. Each application should describe the research project the institution desires to undertake, the facilities available for carrying out the project, the qualifications of personnel to be assigned to it, the anticipated time for completion, and an itemized estimate of annual expenditures for salaries, apparatus, supplies, etc.

Proposals are to be sent in duplicate to the United States Trust Company of New York, 45 Wall Street, New York 5, New York.

On 28 May at 10:00 P.M., Eastern Daylight Time, Columbia Broadcasting System will present a full hour of radio time, "Operation Crossroads." Aside from Vice-Adm. W. H. P. Blandy, who will speak from his flagship en route to Bikini, participants will include Prof. Einstein and the tail-gunner of the B-29 that devastated Hiroshima; Cdr. Harold E. Stassen and a Minneapolis woman who lost three sons in the war; Harold C. Urey and a college freshman; Lt. Gen. George Kenney, U. S. Air Forces, representative to the United Nations' Military Staff Committee, and a worker at the Oak Ridge, Tennessee, atom plant. These people will speak from the auditorium of the Library of Congress, as will former Secretary of the Interior Harold C. Ickes; United Nations Assembly Delegate Archibald MacLeish; Associate Supreme Court Justice William O. Douglas; Senator Brien McMahon, chairman of the Senate Atomic Energy Committee; Representative H. Jerry Voorhis; Secretary of Commerce Henry A. Wallace; and Mrs. Wendell Willkie.

Present for the event at the Library of Congress will be an audience of distinguished statesmen, educators, scientists, military leaders, writers, diplomats, and representatives of the world press.

Eight honorary degrees of Doctor of Science were awarded at the concluding exercises of the Sesquicentennial Celebration of the University of North Carolina, Chapel Hill, on 13 April. Jesse Wakefield Beams, William Walter Cort, Edwin Broun Fred, Hugh Jackson Morgan, George Braxton Pegram, James Stevens Simmons, William Ray Taliaferro, and Robert Sessions Woodworth were the recipients.

The semiannual meeting of the Paleontological Research Institution took place at its headquarters in Ithaca, New York, on Saturday, 6 April.

Announcements were made of: (1) the completion of *Bulletin of American Paleontology*, Vol. 29, No. 116, on "Ordovician Cephalopoda of the Cincinnati region," by R. H. Flower, a publication consisting of 656 pages and 50 full-tone plates; (2) the beginning of presswork on the Jackson Eocene molluscan monograph, with 65 full-tone plates; (3) the availability of G. W. Sinclair's article in *Palaeontographica Americana* on "Canadian Platystrophias"; and (4) the purchase of 20 volumes of Reeve's *Conchologia Iconica* (said to be complete).

The Institution is unfortunately obliged to postpone the duplication of the present plant because of labor conditions and the impossibility of obtaining sufficient building materials.

Recent Deaths

Howard de Forest, emeritus professor of botany at the University of Southern California, died on 4 April in Los Angeles, California.

Alexander A. Baikov, 76, Russian metallurgist and a vice-president of the Academy of Sciences, USSR, in 1943, died on 7 April.

William Waddell Duke, 63, known for his allergy research, died on 10 April in Kansas City, Missouri.

Rafael Requena, 66, Venezuelan archaeologist and anthropologist, died on 20 April in New York City.

Fred M. Meader, 70, bacteriologist who figured in the investigation which led to the isolation of "Typhoid Mary," the classical example of a typhoid carrier, died on 26 April in Detroit, Michigan.

William Orrin Emery, 83, organic chemist and amateur botanist, was found dead on 7 May, in Fairfax County, Virginia. Dr. Emery was the object of an extensive search when he did not return from a field trip.

Glacial Map of North America

The publication of the Geological Society of America of the *Glacial Map of North America* (*Science,* **1941, 93,** 303–305) is the fruit of three years of compilation and cooperative effort by a committee of geologists and a two-year publication process under wartime difficulties and restrictions.

The map is published in two sheets, together measuring 79 by 52 inches, and is drawn on a scale of 72 miles to the inch. It is the first map to represent the Pleistocene glacial features of the whole of North America on any but a very small scale. Published in 23 different color conventions, it represents North America from the Aleutians and Bering Strait to Iceland, and from the North Pole to Cape Hatteras and Los Angeles. Major topographic features are shown by form lines on the land and on the sea floor. In this way the relation of the glaciated areas to highlands and to continental shelves is brought out.

Areas glaciated during each of the four Pleistocene glacial ages, and during the sub-ages of the last glacial age, are differentiated in color wherever a basis for differentiation exists. End moraines are shown individually. The extent of glacial lakes, regions overspread by interglacial and postglacial seas, and existing glaciers are shown by areal conventions. Striations, drumlins, eskers, boulder trains, outlets of glacial lakes, and locations of exposures of fossil-bearing interglacial deposits are among the features shown by appropriate symbols.

Additional detailed information is furnished by more than 150 footnotes printed on the face of the map. A number of inset maps are included, among them a map showing the distribution of loess in central United States.

The work as a whole has been designed to provide a continental view of the extent of glaciation and the distribution of glacial features, instead of focusing attention principally on the southern sector of the North American glaciated region, as has been done in the past.

The map constitutes Part 1 of the Geological Society's *Special Papers Series,* No. 60; Part 2, issued with the map, is a 40-page pamphlet containing explanatory notes and a selected bibliography of North American glacial geology. The map and pamphlet are issued free to Fellows of the Geological Society and are sold to others at a price of $2.00 by the Society (419 West 117th Street, New York 27, New York).

Compilation and editing of the map are the work of a committee of American and Canadian geologists, set up late in 1939 by the National Research Council, as follows: R. F. Flint (chairman), W. C. Alden, E. T. Apfel, H. S. Bostock, S. R. Capps, J. W. Goldthwait, L. M. Gould, G. F. Kay (deceased), M. M. Leighton, Frank Leverett (deceased), Paul MacClintock, D. A. Nichols, G. W. H. Norman, F. T. Thwaites, G. W. White, and G. A. Young.

Governmental agencies that cooperated in the assembling of data include the U. S. Geological Survey, the Bureau of Geology and Topography (Canada), and various State and Provincial geological surveys. The base and first draft of the final map were prepared in Ottawa under the supervision of the Bureau of Geology and Topography (Canada).

Funds for compilation and drafting were provided by the National Research Council, the American Geographical Society, and the Geological Society of America.

The map, the implied correlations, and the accompanying bibliography represent the latest available information and the best judgment of the compilers. They are expected to provide a firm basis for further field studies, which should make it possible in time to construct an improved and more nearly complete glacial map of North America.—*Richard Foster Flint* (The Geological Society of America).

In the Laboratory

The Lifwynn Eye-movement Camera

HANS SYZ

The Lifwynn Foundation, Westport, Connecticut

In connection with the investigation of behavior disorders carried on by the Lifwynn Laboratory, accurate photographic recordings of eye movements were a specific requisite. After surveying the field and experimenting with eye-movement cameras constructed by other laboratories, it was found desirable to develop an apparatus which would meet our special needs, namely, the simultaneous recording of the horizontal and vertical components, the velocity and exact course of motion, and the position and duration of the fixations. It was important not only that these features be recorded simultaneously but also that they be recordable on a single frame and that a quick and easy analysis of each experiment be possible without calculation or other complicated procedures.

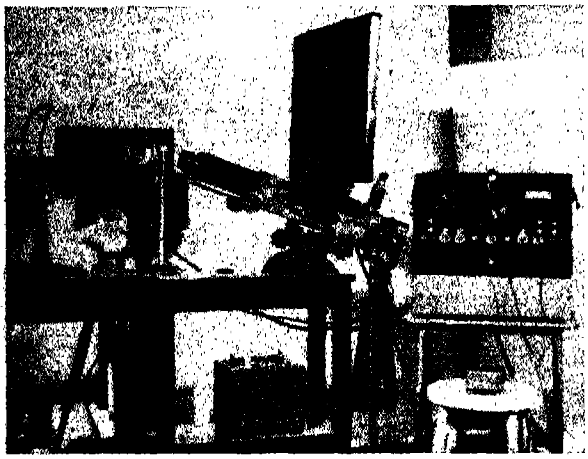


FIG. 1

The Lifwynn Eye-movement Camera, as shown in Fig. 1, was devised and built by Dr. Henry Roger in his laboratory at Sandy Hook, Connecticut. Mr. Charles Robinson assisted in the development and construction of the electrical features, to be reported in detail in a future communication. The writer participated regularly in the discussion of the distinctive features required to be incorporated in the camera and in progressive experimentation with it.

The apparatus consists of three major parts: a camera with film magazine and frame-changing device, a light source, and an electrical control unit. All parts of the apparatus are interconnected by electrical cables. These are operated and controlled from a central electrical control panel.

The camera incorporates the principle of a still camera and uses 35-mm. motion-picture film. The frame size is 18 × 24 mm.—that is, the same as is used in regular silent motion-picture cameras. The frame change is activated by a pulldown, operated by a solenoid which is an integral part of the mechanism itself. The frame change is timed to take effect automatically once every second, but by manual control a longer exposure may be obtained.

The frequency of exposures varies from 5 to 30 per second. These frequencies were chosen arbitrarily following a number of experiments which showed that these rates were most likely to permit an adequate analysis of the photographic impressions. However, the number of exposures may be increased to 60 per second and even more if this should seem desirable.

The accuracy of the time intervals between the exposures is quite reliable. It is achieved by an electrically controlled stroboscopic device which lights up a flash lamp at intervals as set by a dial on the control panel.

In order to register the sequence of the eye movements and the duration of the fixations, a rotating dial is employed through which the flashes are projected on the cornea and from there reflected into the camera. The dial, moving clockwise, shows the changing positions of its bar, which can be analyzed readily on the photogram.

In order to secure sharp photographic impressions of this dial on highly sensitized photographic emulsions a very short exposure is required. The powerful light source needed for this purpose was secured by employing a flash tube controlled by a thyratron tube. Disturbing effects of the light flashes are obviated by means of an ultraviolet filter placed in front of the light source.

With regard to its duration, the experiment can be accurately timed within seconds or minutes by a synchronous timer which not only controls the experimental period but also actuates the shutter in the camera, the frame-changing device, and the dial that rotates in front of the light source. It was found advisable that a single turn of the dial, adjusted to one revolution per second, be registered on a single frame to avoid crowding the photogram and making analysis difficult. If, however, one desires to obtain an over-all picture of a subject's eye movements, it is possible to register a longer period on a single frame.

A projection device permits one to superimpose several frames and also to superimpose the track of the eye movements upon the picture which the subject may be asked to observe during the experiment.

The registration and analysis of eye movements were undertaken as part of the study of the physiological modifications occurring in two forms of attention or adaptation investigated by Burrow and his co-workers. The investigation was undertaken especially with regard to disturbances in attention, as we found that a primary deflection in the process of attention was an invariable accompaniment of disorders of behavior, both individual and social. We had previously found specific alterations of the respiratory function (*1*) and of the electroencephalic potentials (*2, 3*) to be concomitant with these modifications in attention and behavior. These instrumentally measurable and verifiable aspects confirm the distinction made between the two types of attention: (a) *ditention,* as seen in "normal" as well as in neurotic behavior, and (b) *cotention,* which represents the organism's primary phylobiology or its healthy basis of orientation.

References

1. BURROW, TRIGANT. *Nature, Lond.*, 1938, **142**, 156; *Psychosom. Med.*, 1941, **3**, 174-186.
2. BURROW, TRIGANT. *J. Psychol.*, 1943, **15**, 109-114.
3. BURROW, TRIGANT, and GALT, WILLIAM. *J. gen. Psychol.*, 1945, **33**, 269-288.

Inactivation of Penicillin by Zinc Salts

HANS EISNER

Instituto Andrómaco, Montevideo, Uruguay

BERNARDO PORZECANSKI

Instituto de Higiene, Facultad de Medicina de Montevideo

The Oxford investigators and others have reported that penicillin is inactivated by contact with various heavy metals.·

In connection with experiments to determine quantitatively the influence of certain pure metals and their salts, we found that the time needed to inactivate the penicillin is quite different for the various metals and salts. The inactivating process depends on different factors and generally takes several days to complete. Zinc salts (*i.e.* sulfate, acetate, chloride, oxide), however, showed an exceptional behavior in our experiments and inactivated penicillin in a short time. That this particular action of the zinc salts, even in such a low concentration as that used under the conditions of our experiments (1/300–1/60 M) has no perceptible bacteriostatic effects calls for special attention. The inactivation with a well-defined, inorganic, easily sterilizable, and stable substance, such as zinc salts, seems to us to be preferable in some cases to procedures with enzymes or other organic compounds; at least, this method may be of interest as a complement or control of another base. The zinc inactivation method is quite useful to us in determining the effects on penicillin of metals and their salts, particularly because in the presence of these substances the use of enzymes sometimes offers serious difficulties. This preliminary report of the "Zn-inactivation method" may be valuable in cases where usual inactivators have thus far been employed.

EXPERIMENTAL TECHNIQUE

Penicillin: We employed commercial penicillin-sodium of several manufacturers.

Test organism: The H strain of the Oxford investigators or another coagulase positive strain of *Staphylococcus aureus* sensitive to penicillin was used.

Inoculum: Culture media were inoculated with 3 drops (3/50 ml.) of a 12- to 18-hour broth culture.

Culture media: For the serial broth dilution method we used infusion broth (meat infusion and peptone), adjusted to a reaction of about pH 6.5 ±, distributed as a routine in small test tubes, 2 cc. for each tube. For the Oxford cup method we have employed ordinary nutrient agar (the same infusion broth solidified with 2½ per cent agar).

Zinc sulfate: Sterile solutions in water of $ZnSO_4 \cdot 7H_2O$, 5, 10, 25, and 50 per cent, were employed.

Procedures: The inactivation of penicillin by zinc sulfate can be studied by various simple and satisfactory routine procedures.

In the *Oxford cup method,* to each cubic centimeter of nutrient agar, melted and seeded with *Staph. aureus,* 1/50 ml. of one of the zinc sulfate solutions is added according to the desired concentration. We use for this purpose a capillary pipette, standardized to 1 drop = 1.50/ml. The agar is poured into plates, and the glass cups are placed on the agar and filled with the penicillin solution to be studied. Incubation is at 37°. The inactivation of penicillin is recognized by bacterial growth throughout the whole plate.

An *inverted* cup assay is as follows: To nutrient agar melted and seeded with *Staph. aureus,* as already described, the desired amount of penicillin solution is added. The mixture is poured into plates; glass cups are placed in the agar and filled with the corresponding zinc sulfate solution. Penicillin inactivation is judged by observing a zone of *Staph. aureus* growing around each cup. On the rest of the plate there is no bacterial growth.

The broth dilution method consists of adding 1/50 ml./cc. of one of the zinc sulfate solutions to a single tube with penicillin solution in normal saline or pure water, alone or with body fluids. Incubation is at 37°. After adequate time (12–24 hours or more), serial dilutions are made out of this tube, and *Staph. aureus* added to each of these. Incubation is at 37°.

A control tube of penicillin solution without zinc sulfate, stored at 37°, during the same time, is used for comparative measuring of the penicillin potency in serial dilution.

Another assay is as follows: Each tube of a range of graduated penicillin dilution is inoculated with *Staph. aureus*, and zinc sulfate solution is added to the tubes immediately (or after a longer or a shorter time). After some hours (4 or more) the tubes are examined for evidence of growth (reading turbidity).

Discussion

In the inactivation of penicillin by zinc salts are involved factors about which we will report in detail later. Thus far our results seem to indicate that penicillin inactivation by zinc sulfate is closely similar in its course to the penicillinase inactivation process. In both cases, curves which derive from the rate of inactivation significantly differ from the straight line.

In the zinc inactivation method, pH and zinc concentration are of primordial importance. The inactivation rate increases with the concentration of the zinc sulfate employed. When strong zinc sulfate solutions are used, their possible antibacterial effect must be considered. Concentrations of 1–5 mg./cc. liquid medium, as used by us, have no bacteriostatic action in our experiments. Lower concentrations have slow or no penicillin inactivation effect at all. Here it will be of interest to mention that very low quantities of zinc sulfate (1–3 mg./liter) had even been recommended for the stimulation of the penicillin production.

A pH between 6 and 6.8 is preferable for the inactivation process and also appropriate for the staphylococcus growth. The broth used by us allowed concentrations of 1–5 mg. of zinc sulfate per cubic centimeter without need for pH correction. It should be noted that in using the zinc concentrations recommended by us, especially the higher ones, zinc hydroxide may be precipitated out. This does not affect the inactivation process; neither does the zinc hydroxide seem to precipitate or adsorb any appreciable quantity of penicillin. On account of this we use in dilution tests the clear supernatant fluid, even though the same results may be obtained using the fluid with the suspended sediment. Under the conditions of our experiments, 1–5 mg. zinc sulfate inactivate in a few hours (12–24 hours) concentrations of the order of 100 units of penicillin. We have obtained the same results whether serum (human), blood (rabbit) or agar were in the medium. This fact, we believe, makes the zinc inactivation method suitable for culturing blood and other body fluids containing penicillin, for the sterility test of penicillin powder, and, perhaps also, a valuable aid in penicillin assay in mixtures of penicillin with other germicides.

Up to the present, as a result of these studies, we cannot say anything substantial concerning the underlying mechanism of the penicillin inactivation. A purely chemical reaction is highly improbable, considering the amounts of zinc salt in relation to penicillin used.

A Note on Staining Plasmodia

A. W. Ratcliffe

Department of Pathology, St. Mary's Hospital, Inc.,
and *Department of Biology, Evansville College*
Evansville, Indiana

Review of the historical background of malaria has suggested that our conception of plasmodial staining reactions may be incomplete (*3*). The following observations have heightened this impression:

(1) Blood infected with *P. vivax*[1] (produced clinical and typically smear-positive malaria upon therapeutic inoculation), smeared and stained with Wright's stain, was examined by various technicians and by consultant malariologist without recognition of the plasmodium.

(2) Similar blood showed numerous intraerythrocytic organisms, some of which were actively motile, but freshly made and stained smears were searched by a college class in parasitology without demonstration of a single typical parasite.

(3) Smears of blood containing numerous parasites, *P. vivax* (which stained readily when first smeared in Texas), could not, after transportation to Indiana, be stained to show organisms of diagnostic acceptability.

It appeared in this light that solution of the problem of staining these organisms was essential and prerequisite to progress in morphology and also might be helpful in the ancient and recurring problem of smear-negative patients progressing to necropsy demonstration of plasmodia.

Representative of the current concept is the following: "The dilution of the stain and time required for fixing and staining may be varied considerably without changing the quality of the result very much. The pH of the buffer, age of smear, and brand of stain used are important factors which determine the quality of the result" (*2*). Recommendations as to pH range from 7.2 to 6.4. It is indicated that older smears require a lower pH and may require somewhat longer staining time, and that alkaline buffer produces a dark smear while acid buffer produces a red smear.

---

[1] Indiana Central State Hospital strain, received from Indianapolis as fluid blood.

In recent years the only specific suggestion for staining old blood films seems to be the method of Daniels (1907) which, as outlined by Craig (*1*), calls for a preliminary acid-alcohol bath followed by washing and staining in the usual manner. Repeated trial of these methods did not give the desired result. While the gross appearance of the stained smear is more red with an acid buffer in the range mentioned and darker blue with an alkaline buffer, the red was chiefly that of eosin and the blue largely the result of precipitated stain. Our problem was particularly one of failure to obtain (red) staining of the chromatin. Microscopically, despite the red cast with acid buffers, it was the blue which seemed to stain the nuclei of the leucocytes, rather than the azure components of the stain.

This recalled that hematoxylin, also a nuclear stain, is retarded by acid and precipitated by alkali. Moreover, its staining action is hastened by preliminary rinse of tissue sections in the alkaline bluing bath. Trial of Wright's stain showed clear blue in acid solution but purple with a slight precipitate in alkaline solution. Methyl green was blue in acid but purple in alkaline medium. Azure II showed little change. Azure I and Azure B showed darker blue in the acid solution.

On this basis it seemed that azure-staining of the chromatin might be improved and undue precipitation avoided by using alkali as a preliminary bath rather than as a medium for the stain.

Actual use has verified this principle in several recent clinical cases where typical plasmodia could not be found by routine strain but were present, numerous and well stained after the procedure described.

Sodium carbonate and ammonium hydroxide have both been satisfactory. The concentration is best adjusted by pH determination. Fresh smears will not tolerate strong alkali, and brief exposure to pH 8–9 after fixation may suffice. Older smears are not damaged by considerably stronger alkali and seem to require it for comparable effect. Because of this variation it is not yet possible to be specific as to concentration or time. At present the strength is adjusted to give partial, but not complete, hemolysis. The slide is washed and then stained. For some, the usual time suffices, while for other bloods, prolonged staining is a necessary and helpful factor. This alone gives better results than the routine method, but the use of both the alkali and prolonged staining is distinctly preferable. The nuclei of leucocytes should be distinctly overstained, dark reddish-purple. The staining time is perhaps best controlled by this.

By using several hours in the alkaline bath and 24 hours in Giemsa stain, or a comparable solution of Wright's stain, the parasites brought from Texas in March 1944 have finally been stained to present the desired classical picture.

This seems too useful a tool to withhold, although it needs further development. The possibility of materially hastening the result by adding some penetrant (such as Tergitol-7) is being investigated.

References

1. Craig, C. F. *Laboratory diagnosis of protozoan diseases.* Philadelphia: Lea and Febiger, 1942.
2. Mackie, Thomas T., Hunter, George W., III, and Worth, C. Brooke. *Manual of tropical medicine.* Philadelphia: W. B. Saunders, 1945.
3. Ratcliffe, A. W. *J. Ind. St. med. Ass.*, in press.

Letters to the Editor

The Fluorescence of Radium Burns

The fluorescence of scar tissue has been scantly mentioned in past writings in this field. However, it is now widely assumed that cicatrices due to mechanical, electrical, and chemical trauma show little by way of a distinctive response to filtered, long-wave-length, ultraviolet light. Usually tissue damaged by these agents appears lavender or purple to the unaided eye. This excludes the possibility that such scar tissue may contain traces of porphyrins or related substances which would produce a bright red fluorescence, a subject yet open to investigation.

Moreover, it has been assumed that cicatrices due to the effects of X-ray and radium radiations are characterized by a brilliant pearly-white fluorescence under ultraviolet light.

The writer has personally observed numerous instances in which X-ray damage to tissue on various parts of the body fluoresced the pearly-white color. However, it has recently been possible for him to compare the fluorescences of X-ray cicatrices with those caused by radium. In two cases, both adult male and female, tissue damaged in radium therapy not less than 10 years previously exhibited a brilliant light-blue fluorescence under filtered, long-wave-length, *i.e.* 3,650 A., ultraviolet light. In the case of the female, radium irradiation had been employed 15 years previously to remove a small growth on the cheek. The cicatrix was circular, showing a bright-blue fluorescent periphery and a nonresponsive center. The female subject was 25 years of age. In a 55-year-old male, radium had been used 12 years prior for treatment of a growth covering the lower, external part of the nose. The damaged area also fluoresced the same blue, though the intensity was less pronounced.

From these observations it appears necessary to revise the existing concept of the fluorescence of scar tissue as it pertains to the etiologic factor.

JACK DE MENT

Fluorescence Laboratories, Portland 5, Oregon

Interesting Observations in Dissections of the Frog

Medical men occasionally amaze the readers of newspapers and journals with reports of interesting anomalies of human anatomy. Students of general zoology are no less amazed to find that Mother Nature sometimes plays havoc with the internal anatomy of some of her lesser creatures.

In 18 years of directing laboratory dissections of the frog, numerous anatomical anomalies have been called to my attention by puzzled students. One of the most interesting cases was the Anuran specimen upon whom the students bestowed the curious name, "Glass-sides." Apparently, in the course of embryological development, the tissues normally laid down to form the laminated muscles, the obliquus externus and internus, had failed to develop. As a result, the internal organs were clearly visible through a thin sheet of mesentery-like tissue, occupying the normal position of the muscle, extending from the dorsal fascia to the linea alba. The animal had developed to normal size at maturity, and although the intestines were held in by little more than the skin, no ruptures had occurred.

Anomalies of the genital system are not common, but in one male specimen the right testis was lacking. In this same animal the position of the stomach was reversed from left to right.

In the above-mentioned anomalies and in numerous other cases of missing or misplaced organs the animals had developed to normal size and were not apparently affected by these defects.

JAMES A. MULLEN

Biological Laboratory, Fordham University

The Plainview, Texas, Fossil Bison Quarry

A fossil bison quarry at Plainview, in Hale County, Texas, discovered in 1944, was excavated during 1945 by the Bureau of Economic Geology of the University of Texas and the Texas Memorial Museum. The quarry yielded skeletons, in varying degrees of completeness, of between 50 and 100 bison of an extinct species appreciably larger than the modern buffalo. The bison skeletons were found in the filled valley of a stream at a depth of 12 feet. The unusual accumulation of skeletons may have resulted from a bison stampede. With the bison were found 19 projectile points and 8 other artifacts, chiefly or entirely scrapers. The projectile points, while resembling the known Folsom and Yuma points used by prehistoric hunters, are distinctive and have been named Plainview points (*Geol. Soc. Amer. Bull.*, **56**, 1196).

Bison material to the amount of about three tons, as packed for shipment, was removed from the quarry. Included were eight blocks of bones showing the full thickness of the bone bed. Two of these blocks, containing artifacts in place among the bones, will be placed on exhibit in the Texas Memorial Museum at Austin. With this new material the Memorial Museum will have exhibits of "Early Man" and associated fossils from four Texas localities: Malakoff, Henderson County; Cowan Ranch, Roberts County; Berclair terrace of Blanco Creek, Bee County; and Plainview, Hale County.

The only vertebrate fossil found immediately with the bison bones at Plainview is a large wolf, although the same deposits, near by, here yielded the Columbian elephant, *Parelephas columbi*, and a fossil horse, *Equus sp.* as well as an additional artifact, a scraper. Only fragmentary remains have been recovered of the wolf, and the species has not been determined. It is apparently smaller than the great wolf, *Aenocyon ayersi*, found with human materials at the Bee County locality and at Vero Beach, Florida (*Science*, 1916, **44**, 615). The Columbian elephant has been found near, or in association with, human relics at all of the localities here mentioned.

E. H. SELLARDS, *Director*

Texas Memorial Museum, Austin

On "The Rumbling of Thunder"

In a recent article by Samuel R. Cook (*Science*, 1946, 103, 26–27) a "new cause" for the rumbling of thunder is described. He states that he believes this "new cause" to be "more potent" than any of the four causes usually named. This letter is not to dispute either the existence or potence of the new cause, but to raise some further possible questions concerning it.

In the first place, if we assume Mr. Cook's cause to to be the only cause of rumbling, we would logically expect an even distribution of rumblings with the loud clap and diminuendo and those with a crescendo followed by a loud clap. We should also expect many in-between rumblings. This writer has not observed these phenomena in this locality.

In the second place, assuming the arrangement of electrons in the discharge as described (N, 2N, 4N, 8N, . . .), we wonder about the distances between the points where these charges occur. Let us fix the number of electrons at the second cloud as 2^kN. Then, from the loudness of the clap and the rapid diminuendo, must we assume that the distance between the points of 2^kN electrons and $2^{(k-1)}N$ electrons is much shorter than that between the points for N and 2N electrons? Or are we to assume that the distances are random and that this can account for the fluctuations in the loudness of the rumbling?

Finally, the time of continuation of the rumbling needs some consideration. Let us assume two cumulus clouds 6,000 feet up and two miles apart, with the second cloud immediately over the observer—an extreme condition. Then the clap should be heard 5 to 6 seconds after the flash is seen, and the rumbling, if all is audible, for 11 to 12 seconds. But considering the

These are the optical elements of a monocular microscope—condenser, objective and eyepiece

BALCOTE* *for* Microscope Optics

Balcote has already more than proved its worth in actual use on binoculars, photographic lenses, and military optics. Now Bausch & Lomb is announcing this same surface treatment for microscope optical systems!

Eyepieces, binocular bodies, objectives, and condensers will soon be available for your microscopes. Orders will be accepted for delivery as our production facilities will permit.

For complete information, please write Bausch & Lomb Optical Co., 642-5 St. Paul Street, Rochester 2, N. Y.

*Balcote is the revolutionary anti-reflection coating developed by Bausch & Lomb Optical Co.

BAUSCH & LOMB

ESTABLISHED 1853

weakness of the original discharges, the distance covered, absorption in the atmosphere, how much of it will be audible?

Just what relationship exists among these five factors in the rumbling of thunder, if this relationship can be determined definitely, should prove most interesting.

J. Hollie Cross

2015 15th Street, Lubbock, Texas

A New and Effective Hemostatic Agent

Local agents for the control of bleeding have fallen within three groups: (1) physical, such as pressure; (2) protein precipitating, such as Monsel's solution or tannic acid; (3) coagulation accelerators, such as fibrinogen or thromboplastin. Alginic acid derived from marine kelp may be added to the latter group.

When seaweed is broken or damaged in the water, the injury is healed by the plant juices coming into contact with the calcium ion of the sea water. While the alginic acid may be a transitional product in the synthesis of the carbohydrate of the plant, it also acts as a protective colloid and guards the plant against injury. This clotting and healing action may be likened to that of glycoproteins in the animal and the gums of land plants such as cherry, peach, and acacia.

Alginic acid prepared as a powder and applied to bleeding points combines with the calcium and immediately forms a coagulum that seals the wound. The styptic action is prompt, and new tissue is formed. It has been suggested that the nonirritating character of the coagulum is due to a detoxifying property characteristic of acids derived from kindred carbohydrates such as glucuronic acid.

Alginic acid has been used on a series of 100 cases of extraction and minor oral surgery of the mouth. In no case has there been untoward reaction; healing has been unusually prompt and the control of bleeding an added comfort to both patient and operator.

Clifton A. H. Smith

350 Madison Avenue, New York City

Actualités Medico-chirurgicales

At this time, when scientists in formerly occupied countries find great difficulty in bringing themselves up to date on advances that have occurred during the war, it seems appropriate to mention one program designed to this end which has already been under way for some months. Due to the initiative of Prof. E. J. Bigwood, of the University of Brussels, who came to this country during the war, a series of pamphlets, *Actualités medico-chirurgicales*, have been printed here in the French language and are being circulated in Belgium under the joint sponsorship of the Belgian-American Foundation in New York and the Fondation Franqui of Brussels. The authors have been principally American, and the translation has been made by Belgian scientists in this country. Both authors and translators have donated their services. Pamphlets on blood transfusion, penicillin, sulphonamides, protein metabolism, parenteral feeding, viruses, chemotherapy, and pyrogens have already been printed, while others on burns, tuberculosis, DDT, neurology, cancer, virus diseases, and infant psychology are scheduled to appear in the near future. The pamphlets are designed to provide brief surveys to orient the readers to the new developments in a general way, or as a starting point for those who may need to go further into the literature. The pamphlets have been very well received in Belgium, and a limited number have been sent to other countries.

Harold F. Blum

1368 East 53rd Street, Chicago, Illinois

Note on the "Purple" Test for Alloxan

In studying further the "purple" test for alloxan previously described (*Science*, 1945, 101, 536; *Arch. Biochem.*, 1945, 8, 1), we have come to recognize that if iron is present in the solution tested, it may constitute an interfering factor since it gives rise to an evanescent violet color.

The test, as applied to alloxan, consists in reduction by means of cysteine hydrochloride or ascorbic acid, followed by the addition of barium hydroxide to slight alkalinity; a purple color or purple precipitate is then formed. E. Baumann (*Z. physiol. Chem.*, 1883–84, 8, 299) discovered that an aqueous solution of cysteine gives a blue color with ferric chloride, and V. Arnold (*Z. physiol. Chem.*, 1910–11, 70, 314) observed that, on making alkaline, this blue changes to a violet which quickly fades but reappears on shaking. Ascorbic acid also gives a violet color under these conditions (R. W. Herbert, *et al. J. chem. Soc.*, 1933, 1270).

Hence, the test is likely to lead to erroneous conclusions if applied to extracts containing iron.

R. Stuart Tipson and J. A. Ruben

Mellon Institute of Industrial Research and
Montefiore Hospital, Pittsburgh, Pennsylvania

The Record and the Metric System

Under "Scanning Science" (*Science*, 1946, 103, 446) I notice that a few dates have been omitted. At least two of them are of major importance. In 1866 Congress passed a bill making the metric system lawful in the United States. In the same year Congress directed the Treasury to furnish to each state a set of standard weights and measures of the metric system. In 1893 the Treasury issued an order recognizing the meter and kilogram as fundamental standards and that the customary units will be derived from them.

As to coinage, in 1866 Congress fixed the weights of the 5-cent piece at 5 grams. In 1873 Congress fixed the weights of other coins as follows: half dollar, 12.5 grams; quarter dollar, 6.25 grams; and the dime, 2.5 grams.

In the "Scanning Science" mentioned, the omission of the above facts may give unwarranted comfort to opponents of the metric system.

Arthur Bessey Smith

Automatic Electric Laboratories, Inc., Chicago

The Use of Aircraft for Oceanographic Surveys

In the course of some test work with the Catalina Patrol Bomber (Navy PBY) it occurred to the writers that oceanographic surveys of a physical, chemical, and biological nature could be made to advantage, using such aircraft, rather than boats, as an observation vehicle. The advantages to such a procedure are: greater speed, operating economy, simultaneity of observation, and possibility of obtaining data from remote areas.

The question of making observations on sea water for temperature, conductivity, etc. by means of a drag from the airplane at speeds of 90 mph or more can be answered by the suitable design of such drags. The aircraft can safely operate at very low altitudes above the sea in fair weather; hence, relatively short lines with small tear-drop-shaped metal bobs can be dragged in the water without difficulty by these planes at 100 mph. If thermocouples, conductivity cells, etc. were built into these bobs, the whole assembly could be connected to a small winch in the plane and dragged at desired depths. Water samples could be obtained with a similar arrangement.

A few technical characteristics of the aircraft are given below in order to permit assessment of the possibilities of using PBY aircraft for surveys. The maximum range is about 2,500 miles; maximum endurance (time in the air), 24 hours; operating speed range, 85–150 mph; useful load (including fuel), in excess of 10,000 lbs. Such aircraft are now surplus and could, presumably, be obtained for a very nominal figure. Living and messing facilities are limited, but are adequate to care for flights up to 24 hours duration. Adequate space would be available for scientific instruments and a technical group of four or five persons.

In quiet water areas the aircraft can land on the open sea and can be either moored for a while or taxied along at low speeds. It is not suggested that the PBY be used for open sea work in general. It is more suited to the needs of small stations which cannot afford the expense of a large survey ship and its crew, yet which desire to make observations within a radius of 1,000 miles or so. There are other amphibious aircraft which would be entirely suitable for world-wide operations.

LORIN J. MULLINS and WALTER J. NICKERSON
Wayne University, Detroit, Michigan, and
Wheaton College, Norton, Massachusetts

Notice About Sending Reprints to Austria

Prof. Kisser's plea for reprints (*Science*, 1946, 103, 337) sets me to wonder how one does send reprints to Austrian scientists. When I mailed one to a member of the faculty of the Hochschule für Welthandel in Vienna, it was returned to me from the New York 1 Post Office with a sticker referring to the Postal Bulletin of 15 January 1946, which apparently prohibits the mailing of printed matter.

F. FROMM
College of the Sacred Heart, Santurce, Puerto Rico

[Science has checked with the U. S. Post Office, which bears out Dr. Fromm's statements: only one-ounce, first-class mail is accepted for Austria.]

SCIENCE
BOOKS
from the
JAQUES CATTELL PRESS

Rocks and Rivers of America

By ELLIS W. SHULER
Hamilton Professor of Geology and
Dean of the Graduate School of
Southern Methodist University

This book is a practical course in geology and tells in a most lucid manner the story of the earth on which we live. Particular emphasis is placed on the familiar phenomena of the American landscape. The author's stimulating approach captures the reader's interest by endowing the landscape known since childhood with a new and fascinating character. Drawing on his cultural background, Dr. Shuler goes beyond the purely geological and details the relationship between geology and art, literature and particularly, history. For the tourist there is a clear, concise explanation of America's famous natural wonders, including Niagara Falls, the Natural Bridge of Virginia, Carlsbad Caverns and Grand Canyon. Geologist, natural scientist and traveler will find here rich rewards.

"In this excellent book Professor Shuler has marshalled an orderly array of facts concerning the chief land and water forms of the United States. His first chapters deal in a general way with the agents that carve the earth's crust, the waste of lands, the soils, and with the manner in which land is sculptured. Not only has he interpreted in a remarkably clear manner the geology of this country, but he has provided innumerable examples to highlight his general statements. Every reader will find descriptions of several scenic landscapes with which he is familiar."—***American Scientist***

400 pages 105 photographs $4.00

THE JAQUES CATTELL PRESS
LANCASTER, PA.

Book Reviews

The heating of steel. M. H. Mawhinney. New York: Reinhold, 1945. Pp. viii + 265. (Illustrated.) $4.75.

This book treats the heating of steel in an interesting and thorough manner and brings the reader up to date on the technological progress made in this important field during the past 20 years. An outstanding chapter covers the chemical effects of heating steel and includes an excellent review of the present status of atmosphere control. Other chapters relate to fuels and burner equipment, temperature distribution and furnace control, heat transfer and fuel economy, the quenching of steel, alloys and refractories, and steel mill furnaces.

Among those who will find this book of practical value are steel engineers and metallurgists, operating and maintenance personnel, combustion engineers, and furnace designers, as well as research and development engineers interested in steel-heating problems.

The author predicts that the future trend in fuel technology as applied to industrial heating furnaces will probably be toward application of the cheaper fuels to large heating furnaces for temperatures above 2,000° F. For intermediate temperatures (about 1,800° to 2,000° F.) fuel oil and coke-oven gas—the latter used directly, as in the steel mills, or mixed with other gases as supplied by utilities—will probably compete on a straight price basis with the clean gases, such as natural gas, artificial gas, and butane. At still lower temperatures the author states that convection heating is the most logical method for heat transfer.

While the emphasis throughout is on fuel-fired furnaces, attention is given to salt-bath furnaces, electrical resistance heating furnaces, and induction heating. With respect to the last two items it would appear that a more complete treatment would have been well justified.

A. L. Feild

The American Rolling Mill Company
Baltimore, Maryland

Handbook of nonferrous metallurgy. Pt. II: *Recovery of the metals.* (2nd ed.) Donald M. Liddell. (Ed.) New York: McGraw-Hill, 1945. Pp. xi + 721. $7.00.

The second volume of the new edition of the *Handbook of nonferrous metallurgy* deals with the applications of the principles and processes, described in the first volume, to the particular problems arising in the extraction of metals from their ores. This separation of the subject into two parts, one dealing with principles and the other with their application, is an excellent method of presentation. Since publication of the first edition in 1926 this has been one of the best reference works in the field of nonferrous metallurgy. The revised edition, written during the war, has not, in the opinion of this reviewer, done justice to the excellent reputation of the first edition. Undoubtedly the contributors to this volume could not afford to take the necessary time from their essential war activities to make this edition as complete as they wished. Also, they were compelled to omit certain new processes for reasons of military secrecy.

The book contains separate chapters on the principal methods of recovery used for the more important nonferrous metals (copper, lead, zinc, aluminum, magnesium, gold, and silver). The other metals are grouped into several chapters according to their importance and the type of recovery employed. Each chapter is written by a person (or persons) familiar with the particular process involved. This has some advantages, but leads to much nonuniformity in presentation. For example, considerable information is given on the physical and mechanical properties of aluminum and magnesium alloys, while no such information for copper alloys is presented. There is very little information about the production economics of the important metals, although a summary of such information is given for antimony and for tin. The authors of some chapters go into the methods of chemical analysis in great detail, while no methods of analysis are given for some other metals. The bibliographies of some chapters have been brought up to date, while for other chapters the bibliographies are the same as those in the 1926 edition or are omitted entirely. This lack of consideration for the contributors of valuable articles appearing in recent years is unpardonable. In some cases the references are incomplete, the author and date being omitted. In many chapters, undue attention is given to elementary and irrelevant topics, while the treatment of the actual metallurgical operations is inadequate. An example is a long discussion of blast-furnace copper smelting, now almost obsolete, with only a very brief mention of magnesite brick, suspended-arch construction of reverberatory roofs—one of the most important recent advances in copper smelting. The importance of scrap as a source of the metals is underemphasized or completely neglected. Many of the illustrations are so poorly chosen that they defeat their purpose, and there has been no attempt at uniformity in the presentation of flow sheets and diagrams.

The chapter on antimony is well written, but its length is out of proportion to the relative importance of the metal.

For the most part, the book does not indicate the progress, although slight in many cases, which has taken place in nonferrous metallurgy in the last 20 years. In the opinion of this reviewer, the book was assembled too quickly and was very poorly edited. It will be of limited value to students, engineers, or teachers.

Ben H. Alexander

Carnegie Institute of Technology, Pittsburgh

SCIENCE

Vol. 103, No. 2682 Friday, May 24, 1946

Medical Research Mission to the Soviet Union: Part II

A. Baird Hastings and Michael B. Shimkin

THE VISIT TO RUSSIA of the authors, together with Sir Howard W. Florey and Dr. A. G. Sanders of Oxford, during January and February 1944 for the purpose of discussing problems in medical research with Russian medical scientists, as related in *Science*, *1946*, **103**, 605, resulted in numerous contacts with individual investigators in their laboratories. This second installment is an account of visits to the principal laboratories and hospitals during our stay in Moscow.

BLOOD TRANSFUSIONS AND BLOOD SUBSTITUTES

The Soviet Union developed a sound, efficient blood-supply system for its needs during the war (*9*). The Central Institute of Hematology and Blood Transfusion, directed by A. A. Bagdasarov, has 6 affiliated institutes, 72 large collecting stations, and small collecting stations and points numbering over 1,400 and covering the country from Archangel to Rostov. The Central Institute averaged 750 blood collections per day, and 860 tons of blood had been supplied to the Army by 1944.

The donors are examined and typed, and a serologic test for syphilis is done at district posts. After being sent for according to requirements, they undress, put on clean caps, gowns, and trousers that include the feet, and proceed to the surgical rooms which are divided according to the type of donor's blood. Donors of only one blood type are admitted to any one room. Blood donors receive a meal and are eligible for special food rations. It was stated that 250 cc. of blood is taken from the donors the first time and 450 cc. of blood at succeeding visits, with at least a six-week interval between bleedings.

The blood is collected in long vials of 250 cc. with 10 cc. of 25 per cent glucose and 10 cc. of 5 per cent citrate. This mixture can be sterilized within the bottle at pH 4.9. The blood is sealed immediately by compression of an attached rubber tubing, and the cut end is dipped in paraffin and sealed. A final typing of the blood is done at this time as a final check.

The whole blood is kept at 2–6° C., and transported in special boxes by airplane to the front. The Army orders blood in anticipated amounts and for areas needed in their operations. The transport, delivery, and handling of the blood are done by one organization called the "OPK." Blood is used up to 25 days after collection, but seldom remains unused for that long.

At the time of our visit over 80 per cent of the blood collected was supplied to the Army in the form of whole blood. Approximately 20 per cent of the blood was processed and distributed as plasma or serum. Serum was preferred to plasma because a clearer product was obtained.

During the winter of 1941–42, three tons of frozen serum were sent to the front. It was frozen rapidly by the simple expedient of setting it out on the snow. In thawing, the serum is placed in tepid water and the temperature raised to 38° C. within 12 minutes. Dried plasma and serum were obtained by vacuum at room temperature after the addition of 40 cc. of 25 per cent glucose per liter. The ampoule of dried material is connected directly with an ampoule of distilled water, so that reconstitution of the plasma or serum is achieved by opening the connection; solution occurs in 10–15 minutes.

Plasma and serum are drawn off from blood cells after the blood has stood in the cold for four days. They are kept at room temperature for another seven days in a container with a test-tube extension which can be sealed off from the main container and the contents used for bacteriologic and other test purposes.

Other solutions used in transfusion are variations of salt solutions (*1*), except one in which "nonantigenic" casein is used. It was stated that the casein was extracted with alcohol and that materials to which are attributed antigenic properties were thereby removed. We were informed that they have tried this material in 300 cases, without untoward results when up to 30 grams of casein were used, and without reaction upon repetition, although some cases received up to five repeated infusions. The infusion was stated to be efficacious in cases of hypoproteinemia and shock, but had not been tried in burns. It was also reported to stimulate blood cell production and antibody formation.

Interesting "anesthetic solutions," containing hydrocodeinone and ephedrin, and a solution containing alcohol stated to be useful in shock, were also demonstrated.

At the Sklifasovski Hospital, S. S. Yudin reported on his experiences with cadaver blood. During 1935–43, 2,964 cases were bled, 5,092 liters of blood being obtained. Of these, 1,331 liters had to be discarded due to hemolysis, infection, positive serology, or other causes. The average yield from a body was 1.6 liters when bled from the jugular vein only and 3.0 liters when the femoral vein was also drained. Collection of blood must be carried out within three to four hours after death during the summer and within six to eight hours during the winter. Sulfanilamide in 0.8 per cent concentration is added to the blood obtained. The method is impractical for use at the front, but the cadaver blood bank supplied the needs of the hospital.

TYPHUS VACCINE

The Soviet Union was using mouse-lung typhus vaccine, and this product was demonstrated and discussed by M. K. Krontovskaya at the Central Institute of Microbiology and Epidemiology.

The mice are given rickettsia intranasally. The lungs are removed on the third or fourth day after inoculation, ground with quartz, and centrifuged at 1,500 r.p.m. for five to eight minutes; this removes the quartz and the gross lung tissue. The preparation is then centrifuged at 4,000 r.p.m. for two hours, which throws down the rickettsia. Suspensions of rickettsia are emulsified with formalin, 0.2 per cent, to form the vaccine. Use is made of a standard of 1,000 million rickettsia/cc. (800 to 1,200 million/cc. is the allowable fluctuation), which is determined by optical comparisons of each batch with a standard and actual counts.

The Soviet scientists and epidemiologists were reported to be satisfied with the mouse-lung preparation. The main advantages were stated to be the simplicity of its preparation and the uniformity of the material obtained. Among the main objections to the egg vaccine were the sharp, apparently unpredictable drops in the number of rickettsia in some batches of eggs. The main disadvantage of the mouse-lung preparation was the danger of laboratory infection.

Krontovskaya described and later demonstrated interesting morphological differences in rickettsia isolated from mouse lungs at different intervals after inoculation. Two days after inoculation, the rickettsia appear as long, thin, faint, extracellular organisms; in three to four days the organisms begin to assume the small, oval shape usually seen, and in five days the forms are tiny and appear as if they had been fragmented. Reinoculation of these very small forms, however, results in the presence of the long, thin forms in the reinoculated mice, two days after transfer. They consider that the most virulent stage is the long, thin form and therefore sacrifice their mice at about the third day.

Typhus rickettsia is obtained from the blood of human typhus cases. It is passed through lice for three passages, guinea pigs are then injected intraperitoneally with the ground lice for three passages, and the tunica vaginalis fluid is used for inoculation of mice. The culture is then carried on directly as mouse-rickettsia: suspension-mouse transfers.

The schedule of immunization of human beings is three doses of 1 cc. of vaccine at five-day intervals. Immunity is established in one month and lasts for about a year. Booster doses of 0.5 or 1.0 cc. are then given.

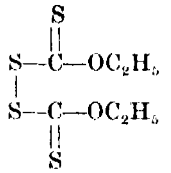
In connection with the time after vaccination that protection occurs, the case of a medical group at the front was cited: 22 were vaccinated more than a month before exposure, and none developed typhus; 2 of the group of 24 had just completed their course, and both developed typhus, although in a mild form.

There was conviction that vaccination against typhus is an efficient procedure, although there was still room for improvement. We were shown the results of one large epidemiologic study in which approximately half of 20,000 comparable individuals were vaccinated with the mouse-lung preparation. Among the nonvaccinated group the rate per 10,000 rose to 32.6 during the peak month, and for a month before and after the peak the rate was 25–30. The highest rate in the vaccinated group was 4, and the curve was practically flat throughout the year's period of observation. Beside this reduction in rate there was a marked decrease in the mortality among those contracting the disease. The average hospitalization period in the vaccinated cases was about 1.5 weeks; for the unvaccinated, about 3 weeks. Convalescence in the vaccinated cases took an average of 12 days, in comparison to 35 days in the nonprotected individuals.

Experimentation with egg vaccine and louse vaccine was being carried out by Krontovskaya and by Smorodintzev. An interesting development in the preparation of Weigl's type of vaccine was the use of an artificial feeding chamber devised by Pshenichnov. Skin is removed from fresh cadavers and spread like a drum over a cylinder, citrated blood infected with rickettsia being pooled underneath. The lice are dropped on this drum and soon start sucking; 2.5 cc. of blood feeds several thousand insects. The lice do not reproduce under these conditions, however, and for maintenance of normal colonies donors still have to be used. The method is widely applicable to the study of diseases involving blood-sucking insects.

INSECTICIDES AND DISINFECTANTS

Apparently the principal insecticidal weapon used by the Soviets against lice and typhus was soap containing a compound designated as "preparation K." The active principle of "K" is bisethylxanthogen:



$$\begin{array}{l} \quad\;\;S \\ \quad\;\;\| \\ S-C-OC_2H_5 \\ | \\ S-C-OC_2H_5 \\ \quad\;\;\| \\ \quad\;\;S \end{array}$$

This compound is combined at 50 per cent strength with soap. Preparation K, emusified with soap, kills lice on contact within six to eight hours, although it paralyzes them sooner. It is also used (20 grams/liter of water) to impregnate clothes. The impregnation is done in special cylinders and is retained in the clothes for at least a month. However, it does not withstand laundering. The main drawback of the material is its onion-like odor.

Since K is difficult to make into a powder, another product, "SK," is used mixed with talc. SK is a chlorinated turpentine, mixed in a 50-50 ratio with an emulsifying agent, and this is mixed with some base such as talc to produce a powder containing 10-20 per cent of SK. The preparation kills lice in six to eight hours. It is not malodorous. Another insecticidal powder, highly but slowly lousicidal, is "DFA," diphenylamine mixed at 25 per cent concentration with talc.

Among insect repellents, use had been made of eugenol (4-allyl-guaiacol) as an impregnating material for nets. To impregnate external clothing against ticks and flying insects a preparation known as "8502" was also used. It consisted of 25 per cent of tetrachlorphenol, 25 per cent of para-oxychlordiphenyl, and 50 per cent emulsifier. Anabasine sulfate, a plant product, was also considered favorably as an insect repellent (*5*).

A newly adopted method of general disinfection, particularly of water, was described. It is based on the use of chlordioxide, ClO_2, which is unstable; the problem was to stabilize it and then to develop means of liberating chlordioxide easily and simply. Stabilization was effected by using a metal salt of chlordioxide, combined with 50 per cent NaCl and 1 per cent $Ca(OH)_2$. This mixture was entitled "Neopantocid." The agent that will liberate ClO_2 is called the "Katalizator" and consists of $Na_2S_2O_7$ mixed with 1 per cent Fe_2SO_4. This product, to differentiate it from the Neopantocid, is colored gray by the addition of carbon particles.

To use the material, 1 gram of Neopantocid is mixed with 1 gram of the Katalizator, and a little water is added. A brown liquid that turns to yellow is formed, due to liberation of chlorine. The mixture has 250 mg. of ClO_2 and is mixed with water to produce the desired concentration. ClO_2 is strongly bactericidal, 100 mg./liter killing all spores, including anthrax, in five minutes. In comparison, while 20 mg. of ClO_2 kills anthrax spores in two hours, 1,000 mg. of Cl_2 does not do so.

ANTIBIOTICS

The Department of Biochemistry of Microbes and Immunity, directed by Z. V. Yermolieva, was studying the problem of antibiotics and related phenomena. Work on penicillin and on gramicidin was based on the publications from British and American sources.

Bacteriophage. Since bacteriophages purified by electrophoresis are protein free and have no respiration, either aerobic or anaerobic, they conclude that phages are nonviable. Phages can be prepared from apples, onions, and carrots, and have been used clinically in the treatment of colitis.

Dysentery phage is prepared in either liquid or solid form, the latter obtained by the electrospray drying method at −40° C. For prophylaxis, a phage-lysate of dysentery organisms is used, 1 cc. containing one billion lysed organisms. The first dose of 1 cc. is given subcutaneously. After two weeks a series of 15-cc. doses are given orally at intervals of three to four days. For active bacillary dysentery, phage treatment is combined with sulfathiazole or with egg lysozyme, given orally. It was stated that the lysozyme was useful in allaying vomiting. For chronic dysentery a combination of phage and lysozyme was stated to promote healing of intestinal ulcerations. For infantile diarrheas phage is used with nicotinic acid, said to enhance the titer of the phage.

Wound phages for pyogenic organisms are used in conjunction with sulfapyridine or sulfanilamide. For necrotic wounds, phage and lysozyme are used, the latter assisting in the removal of sloughs.

Cholera phage is also being tried, and experimental work is being carried out on monkeys at Tashkent.

Lysozyme. Egg lysozyme is used mainly, but lysozyme is also prepared from horse-radish and turnips. It was stated to be bactericidal to streptococcus and staphylococcus, and bacteriostatic for dysentery, typhoid, and cholera.

Clinically it is used for wounds, especially of the cornea, and for preparation of wound beds before skin grafting. In mustard-gas burns it has no specific effect but does reduce secondary complications.

Industrially a crude preparation is used in the processing of caviar. The fish eggs are washed in a solution of 1/1,000,000 and remain fresh for a year. A similar crude preparation is used for soaking flax, the fibers of which can then be separated after only 40 hours of soaking instead of 10 days when plain water is used.

Gramicidin. An active strain of gramicidin-producing bacteria was isolated from the sludge of a slow stream at Tashkent. The organisms differ from the *B. brevis* used by Dubos, and the product is reported to differ from the American gramicidin (*4*). A tryptic digest method is used in the separation of gramicidin. It is supplied in 0.5-cc. ampoules containing 4 per cent gramicidin dissolved in alcohol.

Penicillin. Ninety-three strains of mold, gathered mostly from damp air-raid shelters, were investigated. It was found that one culture, identified as *Penicillium crustosum*[1] by their mycologists, was an active antibiotic producer.

The mold is grown in large, flat bottles on a Czapek-Dox medium containing 8 per cent yeast extract; glucose rather than lactose is used. After four to seven days of incubation, the brew is filtered through paper in a Seitz filter and then through Chamberland candles. It is ampouled directly from the pooling bottles without further purification, and this product is used clinically. The ampoules are stored in a refrigerator and potency maintained for about two months.

Standardization is done by testing the potency against their own culture of *Staph. aureus.* For the most part, tube dilution procedures are used, although it is referred to as the Oxford method. By this method of assay the brew of the mold contained approximately 100–120 units (Soviet)/cc. Monthly production averaged 200 liters (20 million Soviet units), although in December 1944 they produced 500 liters.

Mouse protection experiments were carried out by injecting the animals with staphylococci and penicillin simultaneously in the axilla. Twenty-four hours later, the animals were killed and the axillary lymph nodes cultured. Staphylococci were isolated only from the control animals that received the organisms without the drug.

Penicillin of their production had been used clinically on 179 cases of sepsis and infected wounds, and all were seriously ill. Of these, 160 recovered, 7 died, and no effect was noted in 12. The drug was given intravenously or intramuscularly in 10-cc. doses, and no toxic symptoms have been noticed other than a pyrogenic reaction when 40 cc. are used. Most of the patients received 10,000–50,000 Soviet units of penicillin.

Tests performed by Drs. Florey and Sanders on the Soviet penicillin brew assayed at 30 to 40 units/cc. by the Oxford method. Although a culture of the mold was identified as *P. notatum* in America, its product is apparently somewhat different (*7*).

SURGICAL PROBLEMS

The principles used in the treatment of shock and wounds in the Soviet Union do not differ significantly from those followed in the United States.

Shock. The main principle in the treatment of shock is organizational: *i.e.* treatment of the casualty is carried out as early as possible. Their policy is not to treat wounds, especially extensive wounds, for the first half hour, but to concentrate on shock. This is then followed by surgical treatment of the wound.

At the Physiology Institute of the Academy of Sciences, Lena Stern described the treatment of shock by the intracisternal injection of potassium phosphate. None of the Soviet surgeons in Moscow of whom we made inquiry used this method of treatment.

Wounds. The main principles in the treatment of wounds are: (1) rapid and adequate surgical interference, (2) use of bactericidal and bacteriostatic agents, particularly sulfonamides, and (3) correct immobilization, including plaster casts. Plaster casts were used for soft-tissue wounds as well as for fractures.

The bacterial flora of wounds is always multiple. In secondary operations and in chronic wounds the procedure is to clean up the wound with sulfonamides and, if necessary, to graft early. Tetanus is not a problem due to active immunization, but the sera against gas gangrene are still considered as not adequate.

Burns. Burns are treated as extensive wounds. These cases are not approached without masks, talking is kept at a minimum, and asepsis is rigidly observed. No local anesthetics are used; soap and ammonia are used to clean the burn, and it is covered with dry dressings, not pastes. However, in second-stage burns the Russians had not given up tannic acid and silver nitrate, as they have seen no bad results if sterile precautions are maintained. Tanning is, of course, not used on hands, genitalia, or face. A well-fitting plaster cast is of great importance in these cases. In third-stage burns, early skin grafts are of primary importance.

Frostbite. It was stated that some surgeons preferred the rapid, others the slow, thawing method in treating frostbite. Spassokukovsky advocated the injection of procaine into the artery leading to the affected part. It was stated that the method was not dangerous and the results good. The procedure relieved the spasm of the vessels and was used in combination with slow thawing. During the Finnish War ultraviolet radiation was used with good results in the second and third stages of frostbite; this promoted separation of gangrenous parts, and hospitalization was not longer than following amputation.

---

[1] A sample of this mold presented to us by Prof. Yermolieva was later identified by R. D. Coghill, of the Regional Laboratory at Peoria, as *Penicillium notatum.*

Neurosurgery. The main problem in infected brain injuries was how to combat the complicated mixture of contaminating bacteria associated with such wounds. Of bacteriostatic agents, combinations of sulfanilamide, sulfathiazole, and sulfapyridine were used in the form of emulsions. Grashchenkov had obtained American gramicidin and used it with gratifying results on 250 cases, in half of which the brain was grossly infected and in half of which gramicidin was used prophylactically. Against gram-positive cocci, it was superior to sulfonamides and stimulated the formation of granulation tissue. The only untoward effect noted was bleeding from exuberant granulations if gramicidin was used too freely.

Grashchenkov used nerve grafts preserved in formalin in about 100 cases of peripheral nerve injury. No positive results were seen in nine months, and histologic examination of some cases showed that nerves had not grown through the graft but under and around it. He was using fresh nerve or tannin transplants from the patients themselves in order to bridge the gap for possible nerve regrowth. The results of this procedure were not yet available.

At the hospital of the First Moscow Medical Institute it was reported that intracarotid injection of sulfapyridine was effective in meningitis, meningoencephalitis, and brain abscess. Up to 20 cc. a day of a 10-per cent solution of sulfapyridine in 50 per cent glucose is injected slowly into the common carotid artery. The injections are carried out without skin incision and are easily repeated. In experimental observations on dogs a level of 28 mg./100 cc. of cerebrospinal fluid was reached within 15 minutes. Such concentrations cannot be obtained with intravenous injections. They showed charts of several patients who received the injections for three to six days; the temperature and pulse returned to normal within a few days, and it was stated that they recovered. No statistics were presented as to the incidence of recoveries or on the complications arising from the procedure.

In brain abscesses the above procedure is used preoperatively. This is claimed to help sterilize and wall off the abscess. The abscess is localized before operation by ventriculograms, which give the approximate location. A needle is then introduced into the abscess, and the contents drawn off and replaced by air to outline the space in relation to the ventricles. The operation then proceeds in an attempt to remove the abscess with its capsule.

Chronic wounds. At the Botkin Hospital, gramicidin of Soviet preparation had been used in about 300 cases of chronic infected wounds, and also in some 500 cases prophylactically. The 0.5-cc. ampoule containing 4 per cent gramicidin is mixed with 50 cc. of water for use and applied topically, preparatory to plastic repair. No local toxic reactions had been seen other than occasional bleeding from clean granulating surfaces if treatment is prolonged. No general toxicity had been observed no matter how large the treated surface area was or in cases where the wound was fresh and bleeding. It was also used in empyema, except that of tuberculous etiology, the gramicidin being injected into the pleural cavity after evacuation of the pus.

The course of an infected wound is followed by cleansing the wound of pus and superficial necrotic tissue and making impressions of the surface upon sterile slides that are dropped on and removed without sliding over the tissue. The preparations are stained with Giemsa. The first picture of the infected wound impression is: almost a solid smear of polymorphonuclear leucocytes and many extracellular bacteria. Upon a favorable defense reaction, there are fewer leucocytes and a gradual increase in the number of phagocytosed bacteria. This phenomenon parallels the phagocytic power of leucocytes in peripheral blood, as measured upon exposure of blood *in vitro* to a standard staphylococcus culture. With continued healing, bacteria disappear first, followed by a gradual decrease in the number of leucocytes and appearance of large monocytes. The last favorable stage is the appearance of profibroblasts and fibroblasts, *i.e.* beginning connective tissue-reaction and healing. Reversal of the trend is indicative of worsening of the process, and the observations are used as an index to treatment measures and prognosis. A whole series of impressions are taken if the wound is extensive, and impressions are taken with every change in dressings (*6*).

Wound dystrophy. At the Department of Physiological Chemistry, VIEM, directed by Academician J. O. Parnas, Prof. Kaplansky was studying protein metabolism in cases of wound dystrophy. This syndrome assumed grave importance during the war. Two or three weeks after severe wounding, a certain percentage of patients develop hypoproteinemia. It is believed that this is due to excessive breakdown of proteins as well as to deficient synthesis. In the early stages the urinary nitrogen excretion is markedly elevated, and with exhaustion it is markedly reduced. This metabolic picture resembles that seen in rats in which hypoproteinemia is developed by maintenance upon a 6-per cent protein diet. The type of wound in these cases is not of primary importance, the main factors being severity and nonhealing; sepsis is not necessarily present, although often it complicates the picture. They have seen many cases in which the total blood proteins were 2-3 grams/100 cc. There is, of course, an associated hypochromic anemia, edema, wasting, etc. At autopsy the most striking finding, other than the usual manifestations of cachexia, is the peripheral type of necrosis and hemorrhage in the liver with marked vacuolization of the viable hepatic cells.

Kaplansky was treating these cases with trypsin and pepsin digests of proteins and reported that they were beneficial in some cases. He was able to save several patients who had been despaired of, including one man who had a serum protein level of 1.75 gram per cent; after prolonged treatment the patient was maintaining a level of 7.5 gram per cent. It was considered important to supply the sulfur-containing amino acids, cysteine or methionine; the addition of glutathione was suggested as desirable. The amino acid digests were injected intravenously in concentrations of 10 to 20 per cent by weight in 350-500 cc. of liquid. The infusions were given within an hour, since their patients did not tolerate infusions lasting four hours. It was claimed that, except for occasional vomiting, there were no reactions other than occasional slight rises in temperature and headache.

Restorative surgery. Among surgical operations described were Yudin's total gastrectomies and reconstructions of the esophagus, Frumkin's plastic operations on the genitourinary organs, and the radical resections of septic shoulder and leg joints. Some of the work of Yudin and of Frumkin has been reported in the American literature (*2, 8*).

Operations of the joints were demonstrated at the Botkin Hospital. In the shoulder operation the whole joint, part of the humerus, and the clavicle and scapula may be removed in cases that do not respond to chemotherapy and are obviously septic. In the last 13 cases of resections of the shoulder neither a patient nor an arm had been lost. Two cases were demonstrated; they had a functional arm, although obviously flail-like in motion. X-ray pictures showed thickening of the space between the resected arm and the bone left in the shoulder. The hip operation is obviously more serious. They had done 16 wide resections, including the whole head of the femur, part of the acetabulum, and part of the shaft. As much as 14-16 cm. of bone may be removed. Two cases died; in two, disarticulation operations had to be performed subsequently. But 14 patients retained their legs and after months, with thickening of the soft tissues in the empty area, can in some measure walk upon this extremity. The results were better than any prosthesis, it was said, but the operation was performed only as a last life-saving resort.

At the First Moscow Medical Institute 70 per cent of the operations are done under local anesthesia, including those on the abdomen and chest. In 10 per cent the local infiltration is reinforced by intravenous evipan, and only 20 per cent of the operations are done under general ether anesthesia. No chloroform is used, and ethylene and cyclopropane were not available. Spinal anesthesia was used rarely at this institution because of personal preferences but is very popular elsewhere.

ACS serum. Inquiries were made concerning the antireticulo-cytoxic serum of Bogomoletz. None of the clinicians of whom we made inquiry were able at that time to express an opinion of its clinical value from personal experience. We did not have a personal meeting with Prof. Bogomoletz.

INFECTIOUS AND INTERNAL DISEASES

The Red Army received routine immunizations against typhoid, paratyphoid A and B, tetanus, and smallpox. Typhus vaccine is used upon indications of season and geographic area.

Bacteriophage is used widely, particularly in bacillary dysentery, and prophylactically against dysentery and cholera. The preparations are believed to be effective, both prophylactically and therapeutically. Oral tablets, composed of agar media on which the material is grown after killing the remaining pathogens with chloroform, are given every 10 days during the dysentery season in regions where the disease is prevalent. Acetyl sulfaguanidine has been very effective in dysenteries.

BCG vaccine is used widely, and all children are supposed to receive the vaccination. No ill effects have been encountered with this procedure.

In the Soviet Union pneumonias of Types I and II account for 65 per cent of the cases, which was stated to explain their lower mortality as compared with that in the United States. A combined serum and chemotherapy regime was preferred at the Botkin Hospital, with sulfathiazole or sulfadiazine replacing sulfapyridine.

It was stated at the Botkin Hospital that the expected sharp rise in rheumatic fever did not materialize during the war. Infectious hepatitis or virus pneumonia had not been seen, although they were acquainted with both diseases.

Clinical studies on malaria have been carried out in Middle Asia during the past 20 years. Main reliance in the prevention and treatment of malaria is now placed on quinacrine (atabrine). It was stated that its effectiveness was proportionate to its concentration in blood and particularly in the erythrocytes. For best therapeutic effect, a large primary dose was given intramuscularly as well as by mouth. Usually the drug is given in 2- to 4-day courses with rest intervals of 7 to 10 days, and may be combined with plasmochin. The daily dose, according to the age of the patient, is 0.2 to 0.6 gram. Quinine is used sparingly, in severe cases. Related chemical compounds of the 4-aminoquinoline series had also been investigated (3).

Tularemia vaccine, consisting of heat-killed, glycerinated culture of *B. tularensis,* is used therapeutically as well as prophylactically. Tularemia is not a problem in the USSR except in some regions of Siberia, and recently it had broken out in some reoccupied regions. It was stated that it was transmitted through the oral route due to heavy contamination of food in German storehouses by the feces and urine of infected rats and other rodents. At the Botkin Hospital approximately half of 500 cases of tularemia from the liberated zones were treated with the vaccine. The rationale of using a vaccine therapeutically is that tularemia is a chronic disease and the vaccine might stimulate antibody formation. The vaccine was injected intravenously, in a dose of 50,000 organisms for the first injection. There is a sharp increase in fever, headache, and malaise. Increasing doses for a course of three to six injections are given at three- or four-day intervals. It was stated that the average length of illness with the vaccine was 20 to 30 days, whereas the controls were ill for two to three months. Complications were reduced, and the clinical course was improved.

The number of peptic ulcers has risen markedly during the war. Moreover, there has been a remarkable alteration in the location and sex-distribution since the war. Yudin stated that before the war there were at least three duodenal ulcers for every gastric one; now the ratio is 50:50. Women accounted for 10 per cent or less of the chronic cases; now they constitute 20 per cent. Before the war 90 per cent of the perforations were duodenal, whereas now 50 per cent are gastric; and of these, the rate in women in comparison to men rose from 1.4 to 10 per cent.

NUTRITION AND VITAMINS

At the Institute of the Biology Section, Academy of Sciences, demonstrations and discussions were held on certain aspects of vitamin sources and nutrition.

The green shell of the walnut was considered an excellent source of vitamin C. Treatment is difficult because of the presence of bitter substances and tannins, but 50 grams of crude extract containing 0.8 per cent ascorbic acid can be obtained from 11 kg. of walnut shells. In the first year of production 500 tons of walnuts were processed this way. Pine needles may be used as a source of vitamin C, but the extract is bitter and the vitamin content disappears within two to three days, although it can be stabilized for a week by fermentation. It was stated that a daily intake of 25 mg. of ascorbic acid per person was the goal toward which they were working.

Work was proceeding on "vitamin K_3," a product obtained from maize tassels extracted with organic solvents. The substance has strong antihemorrhagic action, producing a tenfold reduction in clotting time in rabbits following the intravenous injection of 1 cc., representing about 20 grams of raw material. The effect is most pronounced about 90 minutes following injection. The clotting time is reduced in normal animals as well as in those with K-deficiency hypoprothrombinemia.

It was stated that work on cleavage products of carotene revealed that ionone, instead of being physiologically inactive, has powerful antisympathetic effects. Bovine feces were suggested as a source of carotene, since cattle do not utilize it in appreciable amounts.

Methods of dehydrating vegetables and fruit, use of polar lichen as a source of glucose, and the problem of certain toxic molds in grain were also being investigated. Biochemical experiments on plant genetics, particularly wheat and barley, showed correlation between productiveness and hardiness of grain and the catalase activity, and this was used as an index in further crosses between strains to improve the grain.

MISCELLANEOUS OBSERVATIONS

Fundamental research had been continued without marked interruption during the war. Although shortage of technical assistants was reported, recruitment and training of young men and women for scientific research were encouraged.

At the Institute of the Biology Section, Academy of Sciences, V. A. Engelhardt had made important contributions to the chemistry and physiological function of myosin, the mechanism of the Pasteur effect, and on the role of phosphoric acid in photosynthesis. At the Department of Physiological Chemistry, directed by J. O. Parnas, Braunstein was working on thiamine and on the transamination of amino acids; Stepanenko, on the mechanism of glycogenesis and glycolysis; and Bellitzer, on oxidative phosphorylation.

At the First Moscow Medical Institute, Baron was conducting interesting studies on serous membranes, innervation of arteries, and the development of Pacchionian granulations in dogs exposed to rapid rotatory motion.

Studies on immunity and electrophoretic effects of antibiotics on bacteria were being pursued at the Department of Biochemistry of Microbes and Immunity. Localization of points of origin of cardiac impulses on perfused human hearts and localization of damage to peripheral nerves by means of electroneurograms were problems being pursued at the Botkin Hospital. Shabad was resuming his work on the carcinogenic substances found in human tissues, and studies on the effect of tumors on cathepsins were under way.

General Impressions of Medical Research in the Soviet Union

We received a favorable impression of medical research in the Soviet Union as it was being carried out in the few institutions visited by us during our month in Moscow at the height of the war. It is obvious that visits to eight research institutes, three hospitals, and one medical school, augmented by two major conferences and several minor ones, do not represent an adequate sample, and one month is not a sufficient length of time upon which to base any generalizations. We were, of course, shown the best places and met the outstanding workers, and were otherwise treated as guests. Although some extrapolation of our observations can be made, on the whole, any conclusions are limited by the extent of our actual observations. Moreover, the experiences are now two years old.

The Soviet medical authorities made every effort to provide us with personal, unsupervised contacts with their medical scientists and, in so far as they were able, to accede to our requests for specific information on matters pertaining to medical research. The approximately 100 scientists whom we had an opportunity to meet and with whom we discussed questions of medical research were friendly and frank in telling us of their work.

Medical research in the Soviet Union seemed to us to be in a healthy state, although it was carried out under difficulties resulting from the exigencies of war. We were told of experiments which had been unsuccessful as well as successful, of conclusions which had been wrong as well as right, and the work of colleagues was occasionally questioned as well as praised. These experiences emphasize the fact that, at the working level, science and scientists are much the same in the Soviet Union as they are in the United States or elsewhere. Only with respect to facilities for work did there seem to be a difference.

The institutes which we visited were housed in quarters of variable quality. All of the laboratories had suffered from the privations and damage of war, and the equipment was often inadequate compared with that of American laboratories. The hospitals were overcrowded, with stained though clean unbleached bed linen and gowns. These conditions were unavoidable, and allowance must be made for the circumstances. Surgical tables, lamps, and anesthesia equipment even in the best hospitals in Moscow were often antiquated by American standards.

Scientific monographs, textbooks, and journals were badly needed, although L. Bassias, director of the Central State Medical Library, had developed a splendid organization for distributing translations and abstracts to scientific members.

Although Soviet scientists told us in adequate detail of their work, we learned of no new practical research developments in medicine which we would regard as definitely superior to developments in the same field made by English, American, and Canadian scientists. Soviet scientists are progressing soundly along many lines also being developed by our investigators. Both they and we would profit by greater familiarity with the work going forward in both countries. The Soviet scientists and medical governmental authorities admire the work of our scientists, are most friendly toward them, and desire a closer cooperation among the workers of our countries. It is our conviction that increased interchange of scientific knowledge and personnel between the United States and the Soviet Union would be mutually stimulating and beneficial.

References

1. Blum, L. L. *Amer. Rev. Soviet Med.*, 1945, **2**, 278.
2. Frumkin, A. P. *Amer. Rev. Soviet Med.*, 1944, **2**, 14.
3. Galperin, E. P. *Amer. Rev. Soviet Med.*, 1944, **1**, 220.
4. Gause, G. F., and Brazhnikova, M. G. *Amer. Rev. Soviet Med.*, 1944, **2**, 134.
5. Nabokov, V. A. *Amer. Rev. Soviet Med.*, 1945, **2**, 449.
6. Pokrovskaya, M. P., and Makarov, M. S. *Amer. Rev. Soviet Med.*, 1945, **2**, 513.
7. Yermolieva, Z., Kaplun, T., and Levitov, M. *Amer. Rev. Soviet Med.*, 1945, **2**, 247.
8. Yudin, S. S. *Surg. Gynec. Obstet.*, 1944, **78**, 501.
9. ———. Blood symposium. *Amer. Rev. Soviet Med.*, 1945, **2**, 190.

Technical Papers

Acetylcholine Synthesis[1]

Clara Torda and Harold C. Wolff
New York Hospital and Departments of Medicine (Neurology) and Psychiatry, Cornell University Medical College

Acetylcholine participates in the humoral transmission of the effects of nervous stimulation in cholinergic systems. Acetylcholine is released during stimulation of the vagus, the motor nerves to skeletal muscle, the preganglionic fibers of the sympathetic nervous system, and perhaps when impulses cross the synapses of the spinal cord (*1, 2, 4, 5, 10, 13*). It is inferred that acetylcholine is synthesized in the central nervous system and probably also in peripheral nerve tissue, since the amount of acetylcholine liberated during prolonged stimulation may be several times the amount contained in nonstimulated nerve tissue (*9*). Nerve tissues synthesize acetylcholine even *in vitro*, and there is evidence that the synthesis of acetylcholine results from the activity of a specific enzyme (*6–8, 11, 12, 14–16, 32*). The amount of acetylcholine synthesized is probably regulated by the dynamic equilibrium of the various metabolites that surround the enzyme-substrate complex during the process of synthesis.

In the presence of blood serum and spinal fluid more acetylcholine is synthesized by nerve tissue *in vitro* than in the absence of serum and spinal fluid (*16, 17*). Some of the potentiator substances diffuse through Cellophane membrane (*16*). Although serum contains both potentiator and inhibitor substances, the potentiator effect prevails. The potentiator effect may be reduced by various physiological procedures, e.g. less acetylcholine is synthesized in the presence of serum collected from the fatigued arm than in the presence of serum collected from the resting arm (*25*). The effect of the serum and spinal fluid in increasing acetylcholine synthesis is reduced in patients with myasthenia gravis (*16, 17*).

To ascertain the nature of substances having the ability to modify synthesis of acetylcholine the effects of various known metabolites on acetylcholine synthesis *in vitro* were investigated.

Compounds containing energy-rich phosphate bonds (*14, 30*), some products of carbohydrate metabolism (*21*), lower fatty acids (*28*), polypeptides and amino acids (*26*) increase the amount of acetylcholine synthesized. Some decomposition products of nucleic acid (*23*) and of organic phosphates occurring in the body (inosinic acid *23*; ammonia *15, 26*) decrease acetylcholine synthesis.

Of the inorganic ions potassium (*12, 33*), phosphate (*15*), rubidium (*12*), caesium (*12*), barium (*31*), magnesium (*31*), and manganese (*31*) increase the synthesis, whereas potassium in high concentrations (*12*), calcium (*12, 14*), and ammonia (*15, 26*) decrease it.

Hormones also exert an effect on acetylcholine synthesis. Ether extracts of thymus and pancreas decrease the synthesis (*19*), while similar ether extracts of other tissues tested (lymph gland, thyroid, salivary gland, lung, and subcutaneous fat) do not. Since the size of the thymus is regulated by the adrenotrophic hormone of the pituitary gland, this hormone was administered to living animals, and the ability of brain to synthesize acetylcholine was ascertained (*20*). Brain from animals injected with the adrenotrophic hormone synthesized more acetylcholine than brain of noninjected animals. Most steroid hormones decreased the amount of acetylcholine synthesized, but estrogenic hormones and Δ^5 pregnenolone increased the synthesis (*22*). Thyroxine increased the acetylcholine synthesis (*26*), as did epinephrine (*18*). The effect of epinephrine in increasing the amount of acetylcholine synthesized may explain why epinephrine increases the effect of acetylcholine in the central nervous system and improves transmission from nerve to the muscle (*3*).

Vitamins may modify the amount of acetylcholine synthesized. Vitamin E, even in very low concentrations, vitamin C, and most members of the B group increase the amount of acetylcholine synthesized. Vitamin A and K in all the concentrations used, thiamine chloride and vitamin D in higher concentrations decrease the synthesis (*24*).

The variety of the above-enumerated substances suggests that many operate not by a specific action on the enzyme involved in the synthesis of acetylcholine but nonspecifically through other cell processes. Final evaluation of the factors that specifically affect acetylcholine synthesis can be made only after the enzyme system is isolated in pure form.

It is inferred that the enzyme involved in the acetylcholine synthesis contains an active -SH group, since the process is inhibited by agents that decrease the activity of the -SH group (monoiodoacetate, *14, 30*; alloxan, *23*; unsaturated ketones, oxidizing agents, *27*; penicillin, *27*) and is increased by agents protecting the activity of the -SH group (glutathione, cys-

---

[1] This study was aided by a grant from the John and Mary R. Markle Foundation.

teine, *26*; antioxidants, *24*; sodium pyrophosphate in low concentrations, *23*). The synthesis can occur aerobically and anaerobically (in the presence of an excess of energy-rich phosphate bonds, e.g. adenosinetriphosphate, *14, 30*). The amount of acetylcholine synthesized depends on temperature (*14, 16*) and pH (optimum at alkaline pH, *29*). The enzyme is located intracellularly (*8*).

On the basis of the above data the following postulate is presented. Normally occurring constituents of cells and extracellular fluid (serum, spinal fluid) modify the amount of acetylcholine synthesized in the living organism. Further, there is a dynamic equilibrium between potentiator substances (organic phosphates, metabolites of carbohydrates and fats, amino acids, inorganic ions, hormones, vitamins) and inhibitor substances (unsaturated and higher fatty acids, aromatic and heterocyclic compounds, steroid substances, inorganic ions, some decomposition products of nucleoproteins and organic phosphates). During physiological activity the original dynamic equilibrium is disturbed, and new dynamic equilibria are established. Certain metabolites of muscle released during prolonged work decrease the synthesis of acetylcholine (*23, 25, 26*). The accumulation of such metabolites is important in the production of fatigue resulting from indirect stimulation and secondary to decreased acetylcholine synthesis.

References

1. Adam, H. M., McKail, R. A., Obrador, S., and Wilson, W. C. *J. Physiol.*, 1938, **93**, 45P.
2. Bergami, G., Cantoni, G., and Gualtierotti, T. *Arch. Inst. biochem. ital.*, 1936, **8**, 267.
3. Burn, J. H. *Physiol. Rev.*, 1945, **25**, 377.
4. Chute, A. L., Feldberg, W., and Smyth, D. H. *Quart. J. exp. Physiol.*, 1940, **30**, 65.
5. Dale, H. H., Feldberg, W., and Vogt, M. *J. Physiol.*, 1936, **86**, 353.
6. Dikshit, B. B. *Quart. J. exp. Physiol.*, 1938, **28**, 243.
7. Feldberg, W. *J. Physiol.*, 1943, **101**, 432.
8. Feldberg, W. *J. Physiol.*, 1945, **103**, 869.
9. Kahlson, G., and McIntosh, F. C. *J. Physiol.*, 1939, **96**, 277.
10. McIntosh, F. C. *J. Physiol.*, 1938, **94**, 155.
11. Mann, P. J. G., Tennenbaum, M., and Quastel, J. H. *Biochem. J.*, 1938, **32**, 243.
12. Mann, P. J. G., Tennenbaum, M., and Quastel, J. H. *Biochem. J.*, 1939, **33**, 822, 1506.
13. Martini, V., and Cera, R. *Boll. Soc. ital. biol. sper.*, 1939, **14**, 336, 337; *Arch. sci. biol.* 1940, **26**, 103.
14. Nachmansohn, D., and John, H. M. *J. biol. Chem.*, 1945, **158**, 157; Nachmansohn, D., and Machado, A. L. *J. Neurophysiol.*, 1944, **6**, 397.
15. Quastel, J. H., Tennenbaum, M., and Wheatley, A. H. M. *Biochem. J.*, 1936, **30**, 1608.
16. Torda, C., and Wolff, H. G. *Science*, 1943, **98**, 224; *J. clin. Invest.*, 1944, **23**, 649.
17. Torda, C., and Wolff, H. G. *Science*, 1944, **100**, 200.
18. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1944, **56**, 86.
19. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1944, **57**, 69.
20. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1944, **57**, 137.
21. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1944, **57**, 234.
22. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1944, **57**, 327.
23. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1945, **58**, 108.
24. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1945, **58**, 163.
25. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1945, **58**, 242; **59**, 13.
26. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1945, **59**, 181.
27. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1945, **59**, 183.
28. Torda, C., and Wolff, H. G. *Proc. Soc. exp. Biol. Med.*, 1945, **59**, 246.
29. Torda, C., and Wolff, H. G. *J. Pharm. exp. Therap.*, in press.
30. Torda, C., and Wolff, H. G. *J. biol. Chem.*, 1946, **162**, 149.
31. Torda, C., and Wolff, H. G. (To be published.)
32. Trethewie, E. R. *Aust. J. exp. Biol.*, 1938, **16**, 225, 348.
33. Welsh, J. H., and Hyde, J. E. *Amer. J. Physiol.*, 1944, **142**, 512.

Granulocytopenia and Anemia in Rats Fed Diets of Low Casein Content[1]

Arthur Kornberg, Floyd S. Daft, and W. H. Sebrell

Division of Physiology, National Institute of Health, Bethesda, Maryland

Granulocytopenia, correctable by crystalline *L. casei* factor (L.C.F., "folic acid"), has been found to occur occasionally in rats fed highly purified diets (*4*) and regularly when sulfonamides are included in such diets (*3, 4, 7*). Anemia (or impairment in erythropoiesis following hemorrhage) correctable by L.C.F. also has been found in rats fed sulfonamide-containing diets (*1, 3, 6*). Recently we have noted granulocytopenia in rats fed highly purified diets deficient in riboflavin and also among pair-fed, riboflavin-supplemented controls (*5*). Further investigation of this influence of inanition on the production of granulocytopenia has revealed limitation of casein intake to be a highly significant factor.

Weanling albino rats (Osborne and Mendel) were fed one of several purified diets differing only with respect to casein content. Diet No. 1055 contained no casein or protein and consisted principally of Crisco, salt mixture, and dextrose.[2] In the other diets casein (Labco) in varying amounts replaced equivalent weights of dextrose. Total white blood cell counts, polymorphonuclear granulocyte counts, and hematocrit determinations were made as previously described (*6*). For the purposes of this report, granulocytopenia was considered to be present when the polymorphonuclear granulocytes numbered 500 or less per cu. mm. Anemia was considered to be present when the hematocrit was less than 30 vol. per cent.

Of 89 rats fed the casein-free diet (No. 1055), 10 died within 19 days after starting the experimental diet. One or more blood counts were made between the nineteenth and twenty-eighth days on the surviving 79 rats. Granulocytopenia was noted in 75 rats and anemia in 68. The 4 rats without granulocytopenia and the 11 rats without anemia failed to survive 28 days on the experimental diet. The average body weight was 42.5 grams at the start of the experiment and 30.2 grams after 20 days on the diet. Of 6 and 7 rats fed diets containing 2 and 4 per cent casein, respectively, all developed granulocytopenia within 30 days. Anemia was noted only among the rats fed the 2-per cent casein-containing diet. Seven of 8 rats fed an 8-per cent casein-containing diet developed granulocytopenia within 45 days; none had anemia.

---

[1] Presented in part by one of us (A. K.) before the AAAS Vitamin Conference at Gibson Island, Maryland, July 1945.

[2] The casein-free diet No. 1055 consisted of anhydrous dextrose, 86.76 grams; Crisco, 8.0 grams; salt mixture No. 550[3], 4.0 grams; ferric citrate, 1.16 grams; and copper sulfate · $5H_2O$, 0.08 grams. Into this diet were incorporated 1 mg. of thiamine hydrochloride, 2 mg. of riboflavin, 1 mg. of pyridoxine hydrochloride, 4 mg. of calcium pantothenate, 2 mg. of niacin, 200 mg. of choline chloride, 0.001 mg. of biotin, and 0.4 mg. of 2-methyl-1,4-naphthoquinone. Twice weekly each rat received a supplement of 0.25 cc. of corn oil containing 2,000 units of vitamin A and 200 units of vitamin D (Natola) and once weekly 3 mg. of α-tocopherol in 0.03 cc. of ethyl laurate.

TABLE 1

GRANULOCYTOPENIA AND ANEMIA IN RATS FED PROTEIN-FREE DIETS AND PREVENTION WITH CASEIN

Group*	Diet	No. of rats	No. of rats with granulocytopenia‡	No. of rats with anemia‡
A	0 per cent casein	8	8	6§
B	0 per cent casein — 20 γ L.C.F. daily†	8	8	7§
C	18 per cent casein — pair-fed with Group A ..	8	2	0
D	18 per cent casein	8	0	0

* The 4 groups were equal with respect to sex, litter, and weight distribution. Food intake was ad libitum in groups A, B, and D.

† This crystalline fermentation product (2) was administered by pipette to each rat from the outset of the experiment.

‡ Noted within 28 days.

§ The rats which failed to develop anemia died after 19 to 25 days.

Data on the influence of restriction of food intake and the effect of L.C.F. (*2*)[3] administered preventively are in Table 1. These data indicate no significant preventive action by L.C.F. Severe restriction of an 18-per cent casein-containing diet (Group C) failed to produce blood dyscrasias in 6 of 8 rats. The 2 cases of granulocytopenia noted in this group may have resulted from inadequate casein intake.

Several materials were tested for their effectiveness in correction of granulocytopenia developed in rats fed the casein-free diet No. 1055. Treatment was administered daily for 4 days. A recount was made on the day following the last treatment. For the purposes of this report, a response was considered "positive" when the granulocytes numbered 1,000 or more cells per cu. mm. Further details and results of treatment are in Table 2. Rats which failed to survive the treatment period are not considered. When no treatment was administered, there was a progressive decline in granulocyte count and hematocrit value terminating in death. Of 13 rats treated with crystalline L.C.F. or a liver concentrate of L.C.F., only 2 reached granulocyte levels of 1,000 cells per cu. mm. Granulocyte values declined in all of 9 rats fed diets containing casein at levels of 18 or 30 per cent[4] in place of the casein-free diet No. 1055. However, the administration of L.C.F. combined with a change to an 18-per cent casein-containing diet resulted in significant increases in granulocyte count in each of 8 rats. Similarly treatments with L.C.F. combined with the dietary administration of a mixture of purified amino acids[5] produced significant increases in granulocyte count in each of 6 rats. Data on the treatment of anemia are incomplete and therefore are not presented at this time.

TABLE 2

TREATMENT OF GRANULOCYTOPENIA

Treatment	No. of rats	No. of rats with positive response	Poly. granulocytes per cu. mm. (average) Before treatment	Poly. granulocytes per cu. mm. (average) After treatment
L.C.F.* 100 γ	8	2	850	750
L.C.F.† 200 γ subcutaneously	2	0	300	750
L.C.F.†—100 γ + L.C.F. conc.‡ 50 γ	3	0	33	417
Casein diets—18 per cent or 30 per cent	9	0	217	39
L.C.F.†—100 γ + L.C.F. conc.‡ 50 γ + casein diet—18 per cent	3	3	83	4,833
L.C.F.*—100 γ + casein diet—18 per cent	5	5	350	3,090
L.C.F.§—100 γ + amino acid mixture	6	6	317	2,433

* Crystalline fermentation L.C.F. (2) or synthetic L.C.F. (Stokstad). No differences were observed between the activity of the two substances in these experiments.

† Crystalline fermentation L.C.F. (2).

‡ Contained in 0.058 grams of liver concentrate.

§ Synthetic L.C.F. (Stokstad).

Further study is required to determine the identity of the amino acids responsible for the granulocytopoietic activity found in casein or in a mixture of purified amino acids. Such data may help in the elucidation of the mechanism of action of *L. casei* factor and the amino acids in the formation of granulocytes.

---

[3] The crystalline fermentation L.C.F. (2), synthetic L.C.F., and L.C.F. concentrate from liver used in these studies were furnished through the courtesy of Drs. E. L. R. Stokstad and B. L. Hutchings, of Lederle Laboratories, Inc.

[4] Five and 4 rats were fed diets containing 18 per cent and 30 per cent casein, respectively. Average daily intake of these diets per rat was 3.6 grams.

[5] To mixture XII-c of W. C. Rose and S. S. Fierke (*J. biol. Chem.*, 1942, **143**, 115) containing 18 amino acids were added 7.8 grams of dl threonine and 7.8 grams of dl aspartic acid. Of this final mixture, 26.7 grams (representing 18.0 grams of "active" amino acids) replaced an equal weight of dextrose in the casein-free diet No. 1055. Average daily intake of this diet per rat was 2.7 grams.

SUMMARY

Severe granulocytopenia and anemia were developed uniformly in rats fed protein-free diets. Casein (18 per cent) prevented these dyscrasias, but crystalline *L. casei* factor ("folic acid") did not prevent them. In the correction of granulocytopenia in rats fed protein-free diets, *L. casei* factor alone was only slightly effective, diets of higher casein content (18 or 30 per cent) were ineffective under the experimental conditions described. However, *L. casei* factor combined with an 18-per cent casein-containing diet or *L. casei* factor combined with a mixture of purified amino acids were found to be highly effective in correcting the granulocytopenia.

References

1. Daft, F. S., and Sebrell, W. H. *Publ. Hlth Rep.*, 1943, **58**, 1542.
2. Hutchings, B. L., Stokstad, E. L. R., Bohonos, N., and Slobodkin, N. H. *Science*, 1944, **99**, 371.
3. Kornberg, A., Daft, F. S., and Sebrell, W. H. *Science*, 1943, **98**, 20.
4. Kornberg, A., Daft, F. S., and Sebrell, W. H. *Proc. Soc. exp. Biol. Med.*, 1945, **58**, 46.
5. Kornberg, A., Daft, F. S., and Sebrell, W. H. *Arch. Biochem.*, in press.
6. Kornberg, A., Tabor, H., and Sebrell, W. H. *Amer. J. Physiol.*, 1944, **142**, 604.
7. Spicer, S. S., Daft, F. S., Sebrell, W. H., and Ashburn, L. L. *Publ. Hlth Rep.*, 1942, **57**, 1559.

The Presence and Significance of a Leukopenic Factor in Inflammatory Exudates

Valy Menkin
Department of Pathology, Duke University School of Medicine

A number of inflammatory conditions are accompanied by a fall in the number of circulating white blood cells, a so-called state of leukopenia. Fitz-Hugh and Krumbhaar (*1*) regard agranulocytosis as the result of an arrested development of leukocytic elements. The disease involves lymphoid elements as well as granulocytes. These authors therefore speak of the condition as a pernicious leukopenia. A profound leukopenia referable to a virus infection has been recently described to occur in cats (*2, 3*). It is interesting to note on close scrutiny the frequent occurrence of some infection accompanying an agranulocytic process.

The writer has demonstrated the presence of an injury factor located in, or at least closely associated with, the euglobulin fraction of inflammatory exudates (*5*). This substance has been termed necrosin. Recent studies indicate its more frequent recovery in exudates from a severe area of inflammation in which there is usually an appreciable degree of acidity (*7*). The whole euglobulin fraction of exudates not only induces marked cutaneous injury, but likewise it causes in dogs a marked degree of fever and a profound leukopenia (*5, 6*). Subsequent investigations have revealed that the pyrogenic property of the whole euglobulin fraction of exudates is really not referable to necrosin, but that this fever-inducing capacity is caused by a completely different, but closely associated substance, termed by the writer pyrexin (*6*). The present preliminary communication indicates that in inflammatory exudates there exists a leukopenic factor which is not one of the biological attributes of necrosin *per se*. It is closely associated with pyrexin. Yet, it can readily be dissociated, at least to a large extent, from this pyrogenic factor. The presence of such a leukopenic factor in inflammatory exudates may in large part explain, perhaps, the state of leukopenia accompanying numerous inflammatory processes. The leukocytosis-promoting factor present in exudates may well mask the ultimate effect of this leukopenic factor (*4*). In brief, the final blood picture accompanying an acute inflammatory process may to a large extent depend on the relative concentration of either the leukocytosis-promoting factor (LPF) or the leukopenic factor now under discussion, both of which factors are produced at the site of an acute inflammation.

An inflammatory exudate at an acid pH will, when injected into the circulation of a dog, tend to induce a rapid and sharp fall in the number of circulating leukocytes. This is a conspicuous feature within the first hour or so. The average fall in 8 experiments has been found to be 3,778 white blood cells per cubic millimeter or 32.3 per cent. Pyrexin, as isolated from such exudates, is the fraction obtained which has been found to induce a marked leukopenia. The average fall in 10 experiments is 9,980 white blood cells per cubic millimeter, a drop of 79 per cent. It is possible that the simultaneous presence of the LPF in the whole exudate counteracts somewhat the full effectiveness of the leukopenic factor. Such a state of affairs would account for the more striking effect obtained with pyrexin where the LPF is absent. Purified necrosin or normal blood serum utterly fails to induce any such drop in the leukocyte count. Within the usual period of study (about 6 hours) the maximum decrease in the number of circulating leukocytes is, under normal circumstances, negligible.

An attempt has been made to dissociate the leukopenic factor from pyrexin. Some recent evidence indicates that the latter is, or is at least associated with, a polypeptide. It is possible that the leukopenic factor also belongs to this group, especially since it is derived from pyrexin. For this reason pyrexin has been partially hydrolyzed with 0.1 N HCl for about 10 to 15 minutes in an effort to determine whether pyrexin can be in large part inactivated, while leaving behind an active leukopenic factor. The scheme of extraction adopted follows:

SCHEME OF EXTRACTION OF LEUKOPENIC FACTOR
Exudate
$(NH_4)_2SO_4$ at 1/3 saturation
precipitate
treated with distilled water
shake
insoluble material
dialyze until free of SO_4
pyrexin (dried by freezing)
reflux with 0.1 N HCl for 10–15 minutes
cool
N NaOH adjusted to pH 10 or 10.3
concentrate on steam bath to about 1/10th volume
dialyze
evaporate to dryness on steam bath or dry freeze (*leukopenic factor*)

The final material obtained when extracted from pyrexin, as indicated above, still induces a marked leukopenia. This, as in the case of the whole exudate, develops abruptly, and it may last a few hours. The average fall in 14 experiments is 6,146 cells per cubic millimeter, a drop of over 50 per cent. Yet, this leukopenic factor is now essentially dissociated from pyrexin, for it essentially causes no fever when injected into the blood stream of dogs. Preliminary observations in collaboration with Dr. Frederick Bernheim, to be subsequently reported in detail, on the amino nitrogen concentration before and after hydrolysis indicate that the leukopenic factor seems to belong to the group of polypeptides. It is thermostable, for boiling fails to inactivate its effect. Various controls, such, for instance, as the normal variation in leukocyte counts and in temperature level during the period of study (*i.e.* within about 6 hours) or the reagents themselves that were utilized in dissociating the leukopenic factor from pyrexin, all indicate that the effect of the leukopenic factor is indeed real. These studies are being pursued further and will be reported *in extenso* elsewhere.

In brief, evidence has been advanced to indicate that there exists in inflammatory exudates, particularly when obtained from an area of severe inflammation and therefore usually at an acid pH, a leukopenic factor, which *per se* may offer a reasonable explanation for the development of a state of leukopenia with some of the types of acute inflammation. Furthermore, in the exudative material this leukopenic factor seems to be in close association with pyrexin, the pyrogenic factor from which in turn it can to a large extent be separated. The leukopenic factor affects the granulocytes as well as the mononuclear cells, for the latter are likewise depressed. The effect is a general one. The leukopenia is found to exist both in the peripheral circulation and in samples of blood obtained from the heart.

In subsequent studies since this communication was sent for publication, it has been found that, although the leukopenic factor of inflammatory exudate is mostly found in close association with pyrexin, it can be recovered sometimes to some extent in other fractions of exudative material, indicating that it is apparently not exclusively found in association with pyrexin. Furthermore, additional studies seem to indicate that the leukopenic factor of exudates does not primarily deplete the bone marrow, but rather the mechanism involved appears to be a rapid trapping of leukocytes in the alveolar walls of the lungs, in the sinusoids of the liver, and apparently in the spleen. The latter fact may be of significance in our further understanding of the mechanism involved in the acute splenic tumor accompanying numerous inflammatory processes.

References

1. FITZ-HUGH, THOMAS, JR., and KRUMBHAAR, E. B. *Amer. J. med. Sci.*, 1932, **183**, 104.
2. HAMMON, WILLIAM D., and ENDERS, J. F. *J. exp. Med.*, 1939, **69**, 327.
3. LAWRENCE, JOHN S., SYVERTON, J. T., SHAW, J. S., and SMITH, F. P. *Amer. J. Path.*, 1940, **16**, 333.
4. MENKIN, VALY. *Arch. Path.*, 1940, **30**, 363.
5. MENKIN, VALY. *Arch. Path.*, 1943, **36**, 269.
6. MENKIN, VALY. *Arch. Path.*, 1945, **39**, 28; *Proc. Soc. exp. Biol. Med.*, 1943, **54**, 184.
7. MENKIN, VALY. *Fed. Proc.*, 1945, **4**, 149.

The Comparative Toxicity of Thiourea to Four Mutants of *Drosophila melanogaster* [1]

E. D. GOLDSMITH and MORRIS HENRY HARNLY
Department of Anatomy, College of Dentistry, and Washington Square College of Arts and Science, New York University

During the course of an investigation of the effects of a number of drugs upon the development of several genotypes of *Drosophila melanogaster*, the striking toxicity of thiourea[2] was observed. A survey of the literature disclosed several reports dealing with thiourea as an insecticide. Two-per cent solutions of thiourea and phenylthiourea were effective against the webbing clothes moth (*9*). Third instar blowfly larvae died in the third or fourth instar when exposed to thiourea incorporated in their food (*6*). McGovran, Richardson and Piquett (*8*) observed a 92-per cent mortality in the housefly (*Musca domestica*) when third instar larvae were raised on a medium containing 7.5 mg. of thiourea per 23 grams of food. Sixty milligrams of borax were needed to produce the same mortality, and this amount of DDT yielded a death rate of 88 per cent. In another investigation DDT was found to be more effective than a 1-per cent solution of thiourea in reducing the number of emerging flies (*11*). Feeding a mixture containing 10 per cent of allyl thiourea and 90 per cent kaolin to third instar larvae of the silkworm, *Bombyx mori*, produced no unfavorable effects (*1*).

---

[1] Acknowledgment is made to Miss Ada Rakos for technical assistance.

[2] The authors are indebted to Dr. Stanton M. Hardy, of the Lederle Laboratories for a supply of thiourea.

The following is offered as controlled, quantitative evidence of the effectiveness of thiourea in destroying larval diptera.

EXPERIMENTAL METHOD

Pearl's (*10*) synthetic medium, S-101, modified by changing the agar content from 2.2 to 2.5 per cent, served as the basic food. To this medium thiourea was added to give the desired concentrations (Table 1). The food was poured into 1 × 4-inch vials to a depth of ⅞ inch and was yeasted when cool (one drop of a yeast suspension of one cake of Fleischman's yeast per 100 cc. of water was placed on the surface of the food). The cultures were allowed to stand for 24 hours for yeast growth.

TABLE 1

EFFECT OF THIOUREA ON MORTALITY OF *D. melanogaster*

Conc. of thiourea Mg./100 cc. of food	Ebony		Sooty		Black		Wild-type	
	No. of larvae	Mortality %	No. of larvae	Mortality %	No. of larvae	Mortality %	No. of larvae	Mortality %
12.5	200	100			210	100		
10.0	200	100	200	100	210	100		
8.0	400	97	200	98	400	84	360	75
7.5	210	96			210	85		
7.0	400	98	200	83	400	76	385	72
6.0	400	87	200	84	360	65	360	59
5.0	370	75	200	66	440	58		

Ten newly-hatched larvae were placed in each vial and incubated at 25° ± 0.05° C. The four genotypes, ebony, sooty, black, and Wild-type, were tested in these experiments. The animals were examined at intervals during the larval and subsequent developmental periods.

A number of preliminary runs established that at concentrations ranging from 250 mg. to 20 mg. of thiourea/100 cc. of food all larvae died in the first or second instar. This obtained for dosages of 12.5 and 10 mg./100 cc. of food, with a rare individual reaching the third instar and attempting puparium formation. In the final experiments concentrations ranging from 12.5 to 5 mg./100 cc. were used.

RESULTS AND DISCUSSION

Genetic considerations. The data indicate a marked genetic difference in the resistance of these four stocks to the drug, the Wild-type being the most resistant of the four genotypes tested. Black is a II-chromosome recessive mutant, and ebony[11] a III-chromosome recessive mutant from the Wild-type. These two mutants are phenotypically indistinguishable and have normal viability on standard culture media. However, they show a marked difference in resistance to thiourea, black being much more so than ebony. The recessive mutant, sooty, is an allele of ebony and only a slight departure from the Wild-type body color as compared to the black color of the ebony[11] flies. The sooty genotype seems to withstand the drug better than its allele, ebony. This difference may be more marked than the data appear to indicate. The black and ebony[11] stocks were single locus differences from the Wild-type stock, but the sooty stock also carried the mutants, curled wing, stripe, scarlet, peach, roughoid, hairy, and thread—a total of eight mutant loci differences from the Wild-type stock. The cumulative deleterious effects of mutants in compound stocks is well known. It may be that the rather close approach of the sooty mortality to that of its allele, ebony (Table 1), is due in large part to this cumulative effect. If this is so, then the true mortality of the sooty allele is much lower than the figure indicated. This would bring its resistance to the drug more nearly into line with its slight deviation from the Wild-type body color, making the sooty gene both physiologically and morphologically a less extreme variation than the ebony gene from their Wild-type allele. The marked mortality difference between the phenotypically similar black and ebony stocks shows that there must be significant differences in the nonvisible physiological effects of the genes at these two loci. We have observed marked developmental-morphological effects of thiourea at certain dosages. These results are being reported elsewhere. One of us has found different developmental effects of other unrelated drugs on *D. melanogaster* (Harnly, in press). It is evident that the use of drugs might prove a profitable technique in the study of the nature of gene action with *D. melanogaster*.

Thiourea as a larvicide. The numbers of individuals treated and the mortalities of the four genotypes at the indicated dosages are given in Table 1. The mortality values are calculated on the number of emerged adult flies. Examination of the table reveals that a concentration of 12.5 and 10 mg./100 cc. produced 100-per cent mortality in the mutants, ebony, sooty, and black. The trend of the data indicates that a 100-per cent mortality of the wild-type would be produced at some concentration between 15 and 10 mg./100 cc. At lower concentrations of 8-5 mg./100 cc. there was a progressive decrease in the death rate. It is evident that even in concentrations as low as 0.005 per cent thiourea is highly toxic to *D. melanogaster*.

Following recent large-scale field spraying of DDT to destroy mosquitoes, wholesale destruction of fish and other fresh-water life was observed. It should be noted that thiourea has no such lethal action upon fish and amphibia. Immersion of young individuals of *Xiphophorous hellerii* and *Platypoecilus maculatas* in water containing 33.3 mg. of thiourea/100 cc. for periods up to five months resulted in vigorous fish which did, however, exhibit retarded growth and development (*3*). It has been demonstrated that animals (frogs, *4*, *5*, *7*; and mammals, *2*) retarded by thiourea will resume normal growth and development upon discontinuation of the thiourea treatment. It should be emphasized further that the nonlethal concentration employed in the fish experiment is more than 300 per cent higher than that which yielded 100-per cent mortality in Drosophila larvae.

In view of these facts it was considered worth while to investigate the effects of thiourea upon mosquito larvae. The results of these tests will appear in a subsequent publication.

References

1. Ginsburg, J. M., and Cavallito, C. T. *J. econ. Entomol.*, 1936, **29**, 856.
2. Goldsmith, E. D., Gordon, A. S., and Charipper, H. A. *Amer. J. Obstet. Gynec.*, 1945, **49**, 197.
3. Goldsmith, E. D., Nigrelli, R. F., Gordon, A. S., Charipper, H. A., and Gordon, M. *Endocrinology*, 1944, **35**, 132.
4. Gordon, A. S., Goldsmith, E. D., and Charipper, H. A. *Nature, Lond.*, 1943, **152**, 504.
5. Gordon, A. S., Goldsmith, E. D., and Charipper, H. A. *Growth*, 1945, **9**, 19.
6. Hoskins, W. M., Bloxham, H. P., and Van Ess, M. W. *J. econ. Entomol.*, 1940, **33**, 875.
7. Hughes, A. M., and Astwood, E. B. *Endocrinology*, 1944, **34**, 138.
8. McGovran, E. R., Richardson, H. H., and Piquett, P. G. *J. econ. Entomol.*, 1944, **37**, 139.
9. Minaeff, M. G., and Wright, J. H. *Ind. eng. Chem.*, 1929, **21**, 1187.
10. Pearl, R., Allen, A., and Penniman, W. B. D. *Amer. Nat.*, 1926, **60**, 357.
11. Wolfenbarger, D. O., and Hoffman, E. *Poultry Sci.*, 1944, **23**, 545.

News and Notes

Lee A. DuBridge, who returned to the Department of Physics at the University of Rochester in February from the NDRC Radiation Laboratory, Cambridge, has been made president of California Institute of Technology. He succeeds Dr. R. A. Millikan, who retires this spring.

T. Wayland Vaughan, of Washington, D. C., former director of the Scripps Institution of Oceanography, has been awarded the Mary Clark Thompson medal by the National Academy of Sciences. Dr. Vaughan was honored by this award "in recognition of his outstanding achievement in such purposeful and ingenious coordination of observations and generalizations made in and bearing on the fields of stratigraphic geology and paleontology."

Charles B. Fawcett, geographer of the University of London, will be in residence at the Clark University School of Geography during the second semester, February to May 1947. He will offer regular courses of instruction and a series of special lectures during his stay in the United States.

Arthur L. Samuel, of Bell Telephone Laboratories, New York, will become a member of the electrical engineering faculty at the University of Illinois.

Ray G. Daggs has been appointed director of research at the Armored Medical Research Laboratory, Fort Knox, Kentucky.

Jean Brachet, of the University of Brussels, has been appointed visiting professor of zoology at the University of Pennsylvania for the period January to September 1947. He will teach and conduct research in experimental and chemical embryology at the University during the spring term and work at the Marine Biological Laboratory, Woods Hole, during the summer. Thus, graduate students may work continuously with Dr. Brachet during the entire period.

Ernest Laqueur, Institute of Pharmacotherapy, Amsterdam, delivered the Seventh Harvey Lecture of the current series at the New York Academy of Medicine on 18 April 1946. Dr. Laqueur spoke on: "Interrelationships Between Gonadotropic and Sex Hormones."

R. R. McGregor, senior fellow, Mellon Institute of
Science Teachers Association on 1 May 1946. Dr. Mc-
Industrial Research, Pittsburgh, addressed a joint
meeting of the Franklin Institute and the Philadelphia
Gregor spoke on "Silicones: Food for Imagination."

Announcements

Frédéric Bremer, of the University of Brussels, has written that the ship carrying the American scientific periodicals which appeared during the war struck a mine, and that the 1946 periodicals have not been received regularly. He would appreciate receipt of reprints from his American colleagues, especially on the subjects of neurophysiology, physiology of the muscle, and physiology of the circulatory system. These papers will be of great value to Prof. Bremer, as he has been asked to write an article on the general physiology of the nerve centers for the *Annual Review of Physiology,* 1947 (covering works appearing in 1945–1946).

Prof. Bremer's address is: Faculté de Médecine et de Pharmacie, Université de Bruxelles, 115 Boulevard de Waterloo, Bruxelles.

The Department of Animal Husbandry, Pennsylvania State College, is the recipient of a research grant from Sharp and Dohme. This grant is a renewal of previous grants and affords increased financial support to a research program under the direction of W. T. S. Thorp, professor of animal pathology. Dr. Thorp is making an extensive study of various sulfonamides in the treatment of infectious and parasitic diseases in livestock and poultry.

The Committee on Growth of the National Research Council, acting for the American Cancer Society, announces that it will entertain applications for grants in cancer research to become effective 1 July 1947. Applications will be received until 15 September 1946.

Applications for fellowships and senior fellowships in cancer research of the American Cancer Society for the ensuing year will be received until 1 December 1946.

To date the Committee on Growth has recommended to the American Cancer Society a total of 75 research grants and 14 fellowships. The Committee will continue to recommend support of research in the basic sciences and in clinical investigative medicine broadly pertaining to problems of growth. It will continue also to rely heavily for counsel on its advisory Divisions of Chemistry, Biology, Physics, and Clinical Investigations and their subjacent panels in specialized areas of research.

Applications for research grants for the current year will no longer be entertained. Communications should be addressed to: The Committee on Growth, Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Rohrer, Hibler & Replogle announce the opening of another regional office which is located in Suite 520, Terminal Tower, Cleveland, Ohio. J. Elliott Janney is resident partner in charge.

Five fellowships have been established by the New York State Department of Health for the training of physicians in the public health laboratory field. The appointments are for a period of one year and are open to physicians with postgraduate laboratory training who wish additional experience in pathology, bacteriology, or biochemistry to qualify for positions in the public health laboratories in New York. Candidates must be United States citizens who have graduated from a medical school approved by the American Medical Association and who are licensed or eligible to take the examination for license to practice medicine in New York State. Inquiries should be directed to the Division of Laboratories and Research, State Department of Health, Albany 1, New York.

Karl Sandved, Norges Teknische Högskule, Trondheim, Norway, has written:

> As I suppose you can imagine only too well, confinement and prison are not likely to give increased stimulus to scientific research. It was a great event for me and some five other countrymen, therefore, to receive an invitation to England by the British Council. I am just back in Trondheim again after three very interesting and busy weeks in England.
>
> We have had, and still have, certain difficulties in our daily work in the Chemistry Department. Dr. Sörensen is the only one of our prewar professors back in office at the present moment. He had one kidney removed during the war, due to a Gestapo bullet fired throuh his back, when he was in for a third-degree cross-examination. Prof. Tronstad was killed up in the mountains, Prof. Rader is in the hospital, and Prof. Schmidt-Nielsen has retired. I was lucky enough, on my own part, to keep out of the reach of the Gestapo. Still we have had many encouragements, not least from across the Atlantic.—*Victor K. LaMer* (Columbia University).

Philips Technical Review, which was published monthly before the war in four languages by the Research Laboratory of N. V. Philips Gloeilampenfabrieken, Eindhoven, Holland, has resumed publication, according to an announcement by O. S. Duffendack, president of Philips Laboratories, Inc.

Dr. Duffendack explained that publication of international editions of the *Review* was forbidden by the Nazis at the beginning of 1942, although the Dutch edition was permitted to continue until July. The seventh volume, 1942, therefore consisted of only six numbers. It is planned to make these available in the English edition as soon as possible.

First issues of Vol. 8, No. 1, of the English edition, just received in this country, contain papers on: "Sintered glass," by E. G. Dorgelo; "An X-ray apparatus for contact therapy," by H. A. G. Hazeu, J. M. Ledeboer, and J. H. van der Tuuk; "The measurement of impedances particularly on decimetre waves," by J. M. van Hofweegen; and "An apparatus for stroboscopic observation," by S. L. de Bruin.

Subscriptions for the *Review* are being handled exclusively in this country by Elsevier Publishing Company, 215 Fourth Avenue, New York. Yearly subscription price for 12 monthly issues is $5.00 including postage.

A letter addressed to Prof. Frédéric Roman, successor of the late Charles Depéret as professor of geology, University of Lyon, France, was recently returned, marked "Décédé." Roman was a specialist on Cenozoic stratigraphy and mammalian paleontology.—*Horace E. Wood, II* (University of Newark).

The Department of Electrical Engineering of the Illinois Institute of Technology has announced that the Graduate Fellowship in Power Systems Engineering, which the Westinghouse Educational Foundation first established at Illinois Tech in 1945, has been reestablished on a yearly basis for a period of five years, according to Louis T. Radar, chairman. Applications for this year's fellowship are being accepted by Dr. Radar and must be received by him before 1 June 1946. The final decision will be announced to all applicants by 16 June. The appointment will become effective 23 September.

One fellow will be selected each year by a joint committee representing both the Foundation and the Institute. Leading to a degree of Master of Science in Electrical Engineering, this fellowship provides a stipend of $1,500 with all tuition fees paid for 12 months.

Meetings

The American Geophysical Union will hold its 27th annual meeting 27–29 May in the Hall of Government, George Washington University, Washington, D. C. The general meetings of the Union will consist of: an evening lecture session on the volcano, Parícutin; a business session; and an informal smoker at the Cosmos Club. In addition to business meetings, 123 papers have been scheduled for presentation in the sections on geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology, hydrology, and tectonophysics.

The eighth summer conference of the New England Association of Chemistry Teachers will be held 19–24 August at Middlebury College, Middlebury, Vermont. The summer conference has become an event of increasing professional importance among college and secondary school chemistry instructors.

Two symposia are to be held. A symposium on "Electrolysis" will be presented by William B. Meldrum, Haverford College; Frank T. Gucker, Northwestern University; and John A. Timm, Simmons College. A symposium on "Colloids" will be headed by Ernst A. Hauser, Massachusetts Institute of Technology, accompanied by other well-known authorities.

Other program features include: "Silicones," by Francis J. Norton, General Electric Research Laboratories, Schenectady, New York; "Chemistry in Life Insurance," by Sidney H. Roberts, Aetna Life Insurance Company Medical Laboratory, Hartford, Connecticut; "A GI Chemist in a GI School in France," by Andrew J. Scarlett, Dartmouth College; and other papers to be announced.

Elections

The Kappa Chapter of Sigma Xi at Columbia University held its annual initiation ceremony and banquet, on the evening of 7 May, at which 53 members-elect were initiated. Officers elected for 1946 are: Walter Rautenstrauch, president; I. I. Rabi, vice-president; and John S. Karling, secretary-treasurer. Following the banquet, Edward U. Condon, director of the National Bureau of Standards, addressed the meeting on "The Liberation of Atomic Energy."

The American Society of Naturalists has elected the following officers for the year 1946: C. W. Metz, University of Pennsylvania, president; H. A. Spoehr, Carnegie Institution of Washington and Stanford University, vice-president. William R. Taylor, University of Michigan, continues as secretary, and T. M. Sonneborn, Indiana University, as treasurer.

The Utah State Chapter of the Society of the Sigma Xi held its annual business meeting on 8 April 1946. Officers elected at the meeting include: Datus M. Hammond, president; George T. Blanch, vice-president; and Carroll I. Draper, treasurer. The retiring president, J. Stewart Williams, is retained on the Executive Committee with the secretary, Marion T. Bird, who has completed the first year of a three-year term.

The Society of Neurological Surgeons elected as its new president, W. M. Craig, of the Mayo Clinic, Rochester, New York, at a meeting at Vanderbilt University, Nashville, Tennessee, on 9 April.

Recent Deaths

William E. Evans, Jr., 40, associate professor of pharmacology, University of Maryland School of Medicine, died in the University Hospital on 6 May after an illness of short duration.

Letters to the Editor

The Effect of DDT on Cutaneous Sensations in Man

A group of 32 students of Yenching University volunteered for a study of the effect of DDT on cutaneous sensations in the skin when kept in constant contact with this agent. Each student wore a piece of cheesecloth (3 × 4 cm.) saturated with a solution of DDT or mixture of this agent, on the inner surface of one forearm and another piece containing only the diluent on the other arm as a control. The cloths were put on corresponding areas on both sides, 6 cm. above the lowest transverse furrow of the wrist. Cutaneous sensations of the covered areas have been followed through a period of five weeks. The tactile sensation was tested by calibrated Von Frey's hairs, and the pain, cold, and heat sensations by spot distribution.

Students were divided into groups of four or five each, and each group was dressed with a different concentration or mixture of DDT. While no remarkable difference in pain, cold, and heat sensations could be detected, the solution of DDT in olive oil or mixture with vaseline (petrolatum) has been found to desensitize the tactile sensation in most cases, as shown in Table 1. The minimal pressure that would arouse the tactile sensation of the skin in contact with the olive oil solution or vaseline mixture of DDT was 1–2.5 grams per square centimeter higher than the control. These results indicate that oil facilitates the penetration of DDT into the skin.

TABLE 1

Diluent	% DDT	No. of cases showing desensitized tactile sensation	No. of cases showing sensitized tactile sensation	No. of cases showing no effect
Olive oil	20	3	0	1
Olive oil	10	3	0	1
Olive oil	5	2	1	1
Vaseline (petrolatum)	20	3	0	0
"	10	3	0	1
"	5	0	0	4
Talc powder . . .	10	1	0	4
None	100	0	0	4

YIN-CH'ANG CHIN and CHI-HSÜEH T'ANT
Department of Biology, Yenching University
Chengtu, China

Arginine-free Diets and Intestinal Synthesis of Arginine

The white rat is able to synthesize sufficient arginine for moderate growth, reproduction, and partial lactation (H. L. Williams and E. M. Watson, *Rev. Canad. Biol.*, 1944, 3, 426). The possibility that arginine is one of the amino acids which C. J. Martin (*Proc. Soc. exp. Biol. Med.*, 1944, 55, 182) believes to be synthesized within the intestinal tract led to the following investigation.

The stock diet of the colony of albino rats was Fox Chow. The arginine-free diet was prepared as reported earlier by Williams and Watson and, when modified by the addition of 2 per cent sulfasuxidine, was supplemented with 2-me-1,4-naphthoquinone (50 mg./kg. diet), biotin concentrate (200 µg. No. 1,000/kg.), but not with folic acid as employed by Martin.

Because of the lack of available chemicals, this series was restricted to three animals on each of the arginine-free diets. The average weights of these animals while on the test diets are shown in Table 1.

TABLE 1
EFFECT OF ARGININE-FREE DIETS ON WEIGHTS OF MALE WHITE RATS

Weeks	Arginine-free diet	Arginine-free diet + sulfasuxidine
	grams	grams
	151	145
1	147	138
2	147	138
3	149	137
4	150	138
5	152	142
6	157	140
7	162	145
8	152	138
9	145	126

Although the rats failed to gain weight on either diet, possibly due to the restricted intake, there was no indication of the dramatic loss of weight known to accompany acute amino-acid deficiency either by the groups or by individual animals. None of the animals died. Weights, dry weights, and arginine content of the various organs from animals of both series obtained at autopsy compared favorably with comparable data from control animals of the same age fed Fox Chow, in confirmation of findings of Williams and Watson. Thus it is suggested that the intestinal tract is not the source of the arginine synthesized by the rat.

This work was supported by a research fellowship in nutrition from Swift Canadian Company, Ltd.

H. L. WILLIAMS and E. M. WATSON
The Meek Memorial Laboratory
University of Western Ontario Medical School

The Successful Transfer of Ovaries Between Dogs of Different Breed

For a number of years, experiments have been in progress in an endeavor to transplant ovaries between dogs of different breed. The object of the present note is to report two successful transfers of this type and to record preliminary observations on the behavior of the recipient animals. Early unsuccessful experiments were carried out without regard to the physiological status of the dogs, and the present successful transfers appear to be directly related to the use of recipients in oestrus.

The operative procedure employed is extremely simple. After incising the capsule, the ovary is removed at the hilus. The donor's ovary is secured in position in the capsule of the recipient with several fine catgut sutures and the capsule closed. Ovariectomy and transfer are performed on both sides at the same operation.

In both of the successful transfers the donors were bloodhounds and the recipients foxhounds. The bloodhounds were eight years old and had passed the period of productive breeding. The foxhounds were young animals, and each had whelped and raised one litter previous to transfer. Both were in oestrus at the time of operation.

Following transfer, signs of oestrus decreased gradually over a period of four or five days but then recurred in full intensity and continued for a normal cycle of 20 days. Both dogs copulated during this period, but neither conceived. The dogs were followed carefully thereafter, and it was with considerable surprise that signs of a second oestrus were observed 49 days after the start of the previous period in one animal and on the 98th day in the other. It appears significant that such periods of heat do not correspond with the recipient's previous history, but on the contrary, represent a continuation of the bloodhound donor's cycles.

One of the dogs was killed for study 70 days after termination of the second oestrus. The ovaries appeared normal on gross examination, and histological section showed corpora lutea and innumerable follicles in various stages of maturation. An estimation of the number of follicles was not attempted, but it was at once apparent that they greatly exceeded the quantity normally found in the ovary of an eight-year-old dog. The hilus was of interest particularly in its content of blood vessels. Some of them were normal in appearance, filled with blood cells, and undoubtedly represented vascularization of the transplant by the new host. Others were necrotic or showed the extensive hyalinization characteristic of the senile ovary.

The behavior of the animals after operation as well as the morphology of the transplanted organs attest the successful transfer of ovaries between dogs of different breed. It is significant that each of the successful transfers was effected during the recipient's oestrus and that numerous experiments performed on other periods of the sexual cycle terminated in failure. The continuation of the donor's cycle after transfer was contrary to expectation and suggests that the initiation of oestrus is a function of the ovary rather than of the pituitary. These studies are being continued and will be reported in more detail in a later publication.

LEON F. WHITNEY

New Haven, Connecticut

Work of the International Commission on Zoological Nomenclature

Throughout the war and since, the International Commission on Zoological Nomenclature has received much practical help and encouragement from American zoological institutions and from individual American zoologists. This has greatly contributed to the success of the efforts of the Commission to develop its work and thereby raise

LOUIS AGASSIZ AS A TEACHER

By LANE COOPER

A collection of illustrative extracts showing the methods of instruction used by the eminent naturalist, who was one of the most influential zoologists ever to teach in America. Four of his distinguished pupils tell in their own words the process by which they were led to see the various forms of nature through direct and independent observation. This is a book that should be in the hands of all teachers, and of those who are preparing to teach.

> "Every teacher of zoology, not to mention other subjects, ought to obtain this book and ponder it. To the extent that Agassiz influences him he will become a teacher *of* his subject, not merely *about* it."—BIOS

90 pages, $1.50

ORDER FROM YOUR BOOKSELLER OR

COMSTOCK PUBLISHING CO., INC.

124 ROBERTS PLACE ★ ITHACA, NEW YORK

the standard of service rendered to the zoological profession. In spite of wartime difficulties the Commission was able between 1942 and the end of 1945 to issue between 70 and 80 separate publications on various questions of zoological nomenclature. The extremely scanty funds at its disposal made it inevitable that the Commission should charge a relatively high price for the publications so issued. The Commission has always regretted that this should have been necessary, since it holds the view that fundamental publications of this kind should be issued at prices sufficiently low as to be within the financial means of all interested workers. It has therefore always set itself the aim of reducing the prices charged for its publications as soon as its financial resources rendered this practicable.

The Commission has recently reviewed the general position in the light of the encouraging financial results obtained in the year 1945 (full particulars of which, together with the accounts for 1945, will shortly be published by the Commission in its *Bulletin of Zoological Nomenclature*). As the result of this survey, the Commission has decided to cut by 30 per cent the scale of charges for all publications issued after 1 February 1946. This decision involves a considerable financial risk to the Commission. However, it is a wise decision and one which will be widely welcomed by zoologists generally. It is a matter of particular interest to American zoologists, some of whom have been urging the Commission for some time to take action on these lines.

FRANCIS HEMMING

83 Fellows Road (Garden Flat), London, N. W. 3

Scientific Independence in Russia

In his reply to Dr. Asmous on Russia, Mr. Gaposchkin (*Science*, 1946, 103, 404) appears to evade all of the issues completely. He starts out by saying that it is surprising that in 1946 a letter such as that of Dr. Asmous could appear in a scientific periodical. To support that thesis he suggests that Dr. Asmous' life and the lives of all other Americans have been saved by Russia. That statement, even if it were true, would be quite beside the point. Dr. Asmous, in his letter, repeated the charge already made by K. Sax that "science (in the USSR) must conform to political philosophy." Mr. Gaposchkin says not a word in answer to that charge. He remains silent regarding the question of the circumstances surrounding the death of N. Vavilov, a question which has for some time caused, and continues to cause, much mental distress among the latter's scientific colleagues in all parts of the world. While the case of N. Vavilov is a single instance, does it not constitute a symptom of a serious disorder? Can scientists, or indeed any other citizens of democracies, afford to overlook that symptom or the ailment to which it points? Is it too much to expect of those who wish to hold a brief for the independence of science and scientists in the USSR that they either satisfy their colleagues that such charges are unfounded or that the basis for them has ceased to exist?

P. J. OLSON

Division of Plant Science, University of Manitoba

Book Reviews

Essentials of general chemistry. B. Smith Hopkins and John C. Bailar, Jr. Boston: D. C. Heath, 1946. Pp. v + 520. (Illustrated.) $3.50.

In the freshman course in general chemistry the teacher must attempt to accomplish much more than to start the training of specialists. In addition to future chemists, those enrolled in the course will include both students who have studied chemistry in high school and those who have not; students preparing for such diverse professional fields as engineering, medicine, nursing, home economics, and agriculture; and students for whom the beginning course in chemistry will be their only contact with scientific thought in their entire college program. Enrollment in the general chemistry course may be as large as 3,000 in many of the state universities, and the teacher may be required to pass all but a small percentage of these. The writing of a successful textbook for such an audience requires great skill and experience, and it is to the credit of the authors that they have succeeded so well.

By the inclusion of a greater amount of descriptive chemistry than is usual for textbooks at this level they attempt to make up for the deficiencies of students with poor preparation; and by the skillful introduction of modern theory and using it to explain and correlate the descriptive material throughout the book, they make their treatment sufficiently interesting and alive to stimulate the attention of the better-prepared students with professional aims. The care with which the content has been chosen is reflected in the list of "references for further reading" at the end of each chapter. These have been selected from the large mass of chemical books and magazine articles, with the maturity of the freshman student in mind, and include items published just before the book went to press. By means of this extensive and well-chosen bibliography the student is encouraged to start his acquaintance with the vast literature of chemistry and to enlarge his knowledge beyond the scope of the textbook.

The treatment of modern chemical theories is thoroughly up to date. This is not surprising, since the authors have been at the forefront in the recent renaissance of inorganic chemistry in this country. The atomic bomb, however, has received what is probably the least hysterical account ever published on the subject. The topic upon which so many millions of words have been published since 6 August 1945 has been accorded fewer than 400! One may surmise that these were interpolated into the galleys at the last moment and that in future editions there will be some expansion of this revolutionary topic.

It is hoped that this book will receive the wide acceptance that it deserves as it represents a genuine advance in textbooks for the general college course.

LAURENCE S. FOSTER

Research Laboratory, Watertown Arsenal
Watertown, Massachusetts

SCIENCE

Vol. 103, No. 2683 Friday, May 31, 1946

The Nature and Need of Educational Research

Douglas E. Scates

Duke University

THE MOVEMENT FOR FEDERAL SUPPORT of scientific research began last summer with the physical sciences, but hearings before a subcommittee[1] in October made it clear that the social sciences had their own contribution to make to national welfare and security. The proposals currently being considered in the Senate and being discussed in scientific periodicals are of immediate concern to education as one of the social sciences. It is the purpose here to give a preliminary sketch of changes in the form of support for educational research which are needed if this field of research is to contribute appropriately to the progress of our society.

The main problems of education cannot be solved with research facilities which are now available. Under existing conditions our central problems are not even likely to be attacked—certainly, not for a long time. Most of our research is being conducted by individuals, working usually alone and employing toilsome procedures. The approaches to educational problems are commonly made under conditions suited to historical work and individual deliberation. The effect of these conditions on the kind of work done is to make impracticable the gathering of extensive field or laboratory data; to preclude the study of long-time growth problems; to exclude large-scale geographical problems; and to minimize the cultivation of those technical insights and sharp penetrations which come from group discussion and cooperative endeavor. The effect of these conditions on the quantity of work done is to obtain from each individual research worker only a small part of his maximum potential contribution, because of his having to do so much of the work personally, and to obtain in the aggregate a quantity of educational research far below the level necessary for the proper functioning of our society.

In terms of sheer number, the large proportion of our studies are being made by graduate students writing Masters' and Doctors' theses. And, because of the professional character of their training, they are likely to be urged to select problems having a connection with their field of practical work, rather than choose problems which are designed to test hypotheses and round out theory. Professors interested in research work diligently, possibly with some relief in their teaching schedule, but usually singlehandedly, and often with nothing whatever in the way of funds for the purpose. There are a number of research bureaus connected with higher education institutions, and these set an example which affords hope for the future; but they are far too few in number and have too small a budget. The U. S. Office of Education has been concerned largely with reports, summaries, and survey data. State and city research bureaus are concerned with immediate and usually local problems.

The great majority of persons who are interested in relatively fundamental research labor under a pattern of research support which evolved during an earlier period. We are now attempting to carry on under this pattern while living in a world of quick change, rapid progress, and tremendous competition. Our universities, largely because of financial necessity, are continuing a tradition of individual scholarship and personal research which is delightful to those who enjoy the stimulation of participating in it, but which is entirely inadequate to serve the needs of modern social progress. Our Western World is moving rapidly ahead—with our aid if we can keep up, with our hindrance if we cannot. We have recently been talking much about going forward in the postwar world; but if we are to have in this emerging period an education which is in any way distinctive, we will of necessity have an expanded and quickened research program commensurate to the task of serving an ever more intricate and kaleidoscopic civilization. There are increasingly great and increasingly acute problems which depend for solution on educational research.

There is still largely prevalent the notion that research in the social sciences is bibliographical work.

---

[1] See *Science legislation; analytical summary of testimony.* (Appendix to Report from the Subcommittee on War Mobilization to the Committee on Military Affairs, U. S. Senate. Subcommittee Monograph No. 5.) Washington, D. C.: U. S. Government Printing Office, 1945. See also *Hearings on science legislation* (S. 1297 and related bills), which are now available in published form in five volumes.

The library is a basic provision, needed in all sciences. But in those centers where social science research is being carried on vigorously it is an active, aggressive enterprise, taking its orientation not from books but from social life as it is being lived. It deals with human beings currently in action. It seeks data on the problems faced by individuals who are still looking forward. It is concerned with yesterday as a means of understanding today, and with today as a means of determining tomorrow. Students must turn to the written record to know what has previously been proposed and tried; but scientists must turn to the laboratory and to the field for fresh data and final tests.

There is on the part of many physical scientists the feeling that social problems are solely matters of conflict between interests which are to be "solved" by methods of rhetoric or the show of force. Social problems typically do involve competing sets of values, and their scientific study is likely to include certain elements which are absent from physical science. We cannot hope, and we do not wish, to make social science in all respects the same as physical science. But we can hope, and we do desire, to make social science as effective in its sphere as physical science is among physical things. We may point out that social science has been successful, in the same way that physical science has, in noting and quantifying many regularities in the realm of human living and in showing their dependence on measured amounts of conditioning factors.

On the applied side, the social and physical sciences are again similar. The physical scientist has not succeeded in eradicating friction, but he does hope to avoid explosions. So with the social scientist. In the physical field there are no fewer opportunities than in the social for the opposition of strong forces or for their dangerous disproportion. In both fields we seek forms of operation which will regularize and channel the expression of forces so that desired results may be obtained, with increasing efficiency and ever more certainty. The industrial physicist or chemist can tell management what certain amounts of certain substances will do under certain operating conditions. So the social scientist can explain to deliberative bodies the steps necessary to produce certain desired results; and knowing these things, the group can think more clearly and decide more wisely than if the issues are hazy, the elements unanalyzed, and the whole matter left to the relative effectiveness of competing vocal cords.

The social scientist must collect raw data and then analyze those data in order to produce specific or generalized truths. He commonly needs access to groups of pupils or adults, usually under specified conditions—perhaps controlled, perhaps experimental, perhaps representing differing cultures; he needs access to tabulating and calculating machines for statistical analysis; he needs professionally trained assistants, working in something of a stable organization, to aid in carrying on the work of gathering, classifying, and analyzing large masses of data.

Let us look a little more closely at the sources of data and the kinds of problems for which they serve. Roughly, social science data lie in three directions. The first general source is the field study. This may embrace any group of persons, in this country or in other lands, representing modern or primitive cultures. Studies of how people live, grow, and implant their culture in each oncoming generation, under different physical conditions, economies, customs, and ideals, provide descriptive and comparative data of great value. They reveal the existence and relative importance of factors which, under more limited conditions of observation, are either ignored or assumed not to exist. Such studies deal usually with the large outlines of social and educational structure, give us many suggestions as to the variety of patterns which are workable, and prevent us from drawing false conclusions.

In these field studies we may be interested in general, over-all descriptions, or we may wish to single out certain factors for special study. We may make a quantitative survey for analytical, normative, and comparative purposes, or we may be concerned with the more immediate interaction between forces and consequences, leading to causal-comparative, ecological, and correlational studies. For example, one may desire an inventory of the learning problems faced by children from bilingual homes of specified socioeconomic levels. One may seek to ascertain what factors discourage young people of high native ability from continuing through high school and college. One may ask: "To what extent and in what ways does education pay, granted equally favorable economic conditions?"

A second source of data is the experimental study. Here we have typically the laboratory and the controlled classroom or experimental school. Data from experiments give results on principles of learning, on the efficiency of different methods of teaching, on the value of different kinds of incentives, and so on. This is the type of study which, in the social sciences, corresponds most closely to typical work in the physical sciences. It is not, in our field, any more scientific than other forms of research, nor is it necessarily more valuable; each type of work is essential for its own area of understanding. For certain social experiments it is necessary again to go into the field, since problems of morale, of loyalty, of motivation call for large groups of persons under conditions generally representing their ordinary walks of life but with experimental factors present.

The third large source of data in social research is the longitudinal study. This approach yields data on growth, on learning over extended periods, and on the long-time interaction of varying factors. Both normative interest and experimental attack are here represented, with another dimension—time—added in. The longitudinal approach is necessary to obtain natural case histories, such as those needed by the physician to know the normal course of a disease, those needed by the sociologist to relate antecedents and consequents in the unfolding of delinquent and criminal careers, and those needed by the educator to ascertain whether precocious and brilliant youngsters make good in later life. What are the case histories of mature personality maladjustments, what experiences lead up to them, and what are their early signs? How helpful are certain of our common forms of education in later life? Of those students trained in a specific vocation in high school, how many later work in that field? In addition to such natural histories we need results of long-time experimentally controlled factors. What is the effect of a learning experiment carried out, not for three or six months, but for twelve years of elementary and high school education? Can intelligence be improved, or is it constant for a given individual? To what extent can education for specific ends be made to carry over into adult habits and community affairs?

When one compares the work necessary in gathering data from these sources with the normal classroom-office-library routine of college professors, the difficulty of doing fundamental research becomes clear. There are but few instances in the social sciences, and especially in education, where professors are given the funds and other administrative concessions necessary to do anything adequate in the way of gathering and analyzing fresh data on problems of some magnitude. Individuals with scholarly inclinations do find worthwhile problems of the type and size they can attack singlehandedly; but all such problems combined and worked on indefinitely will still not make up the range of essential research, for the most fundamental problems cannot be attacked by individuals working alone. The painstaking development of insights and the thoughtful spinning of new theories are necessary and can be done in part by individuals; but such work is most prolific and helpful when it grows out of, and is supplemented by, a large amount of empirical study to guide thinking and to try out the generalizations being put forward. Science does not progress without imagination and venturesome suggestion, but neither does it make solid gains without gathering data to test each plausible proposal. Rationalization precedes empiricism at constant peril.

The means for bringing the routine of research-minded professors more nearly into line with the accelerated production rate demanded by modern life is to be found principally in terms of adequate funds. Colleges and universities cannot provide the money necessary to capitalize on the existing research capacities of their faculties without either increasing their income two- or threefold or greatly curtailing their teaching. To embark on the latter course at a time when our civilization is calling for more people with more education would be unreasonable. Universities must still honor their first obligation to teaching. But meanwhile society has a crying need for productive work in the social sciences which cannot be satisfied by existing patterns of research support.

The effect of liberal amounts of money on the rate of research production has been abundantly demonstrated during the recent war.[2] The newspapers have released accounts of many new inventions. Most outstanding is the atomic bomb which, according to newspaper reports, cost some $3,500,000,000. In the biochemical field, a substitute for quinine is a striking example of what can be done under urgency and financial adequacy. According to reports,[3] $5,000,000 was set aside for this work, with the result that we now have several drugs *superior* to quinine in the treatment of malaria. In both of these instances, and in numerous others, the desired results were achieved because good research men were brought together, were given a liberal budget, and were told to produce. Results were demanded, paid for, and delivered.

One may reasonably ask: "Why not spend comparable sums in an effort to avoid any occasion for using the atomic bomb?" That is certainly the hope of all people. The only answer is that our society has not yet come to think in terms of social science. We have confidence in the physical and biological sciences to the extent of the expenditures reported; social science has had no such amounts given to it by which to produce spectacular results. We would not expect to get impressive returns in the physical sciences on a niggardly outlay; neither can we expect to do so in the social sciences. It is becoming literally true that society can buy almost any result it wishes; it cannot, however, do so without paying a commensurate prise. These comments do not mean that research comes in small packets, already on a shelf, to be taken down when wanted, but they do mean that there can be great faith in the creative genius of man when his working conditions are good and when the need is urgent. We have the men; we have the need. The question is whether we shall supply the essential working conditions.

---

[2] It has been suggested by M. L. Tainter in "An industrial view of research trends" (*Science*, 1946, 103, 95–99) that research productivity *per man hour* of research work during the war was not, on the average, increased. That scarcely has bearing on the fundamental point that by employing more persons more research will be undertaken and completed, and that by grouping workers and employing assistants more basic problems will be undertaken. The research program *per calendar year* was amazingly stepped up during the war.

[3] Associated Press dispatch by Frank Carey, 3 January 1946. See also "Wartime research in malaria," by the Board for the Coordination of Malarial Studies (*Science*, 1946, 103, 8–9).

One may ask what amount of money would be called for in order to carry on the research in the social sciences needed by our society and by the world. The only correct answer is that the amount depends on the results wanted and the speed with which they are wanted. It is possible, however, to give something of a picture of the structure of research provisions which would seem, on a priori grounds, to be desirable; and it may be reasonable to make certain suggestions as to amounts that could be used to advantage under present conditions. In doing so, the present writer can give only his own ideas, and those concern only educational research; other social fields must produce their estimates of needs.

It seems clear that allowances must be thought of in terms of different levels of work, called for by different types of problems or by different degrees of intensity with which it seems desirable to pursue different problems. Normally there would be a small number of very large—or very important—problems which would demand large expenditures. These can be estimated only roughly. At any time there might be from one to half a dozen projects going forward, each of which would involve from $75,000 to $500,000 or more, though not necessarily this much each year.[4] These would probably be nationwide undertakings, though not all of the survey type. There are large experiments to be undertaken, with large numbers of persons, which would be costly but are essential to social progress and control.

On a more limited level, research centers of the types which have proved so valuable in contributing to educational research in recent years should be established in some 50 to 100 places throughout the country. One need but mention the Institute of Educational Research, with its several divisions, at Teachers College, Columbia University, the Institute of Human Relations at Yale University, the Child Welfare Research Station at the State University of Iowa, and similar centers at the Universities of California, Chicago, and elsewhere, to suggest the basic importance of this organized form of research for producing vital results. It is possible also that national organizations which exist solely for the purpose of fostering research, such as the American Educational Research Association or the Society for Research in Child Development, should have the disbursal of some research funds under their control. The amount needed by each such center or agency might range from $10,000 to $50,000 or more per year, again depending on the kind of problems attacked and the rate of work. Centers of the types referred to, organized with some permanence, are in a position to work on long-range problems which the individual research worker cannot or will not undertake.

In addition to such research through organized staffs, the rich potentialities of individual work should be freed from the limitations which now restrict it to problems which are convenient for singlehanded attack. Professors or other qualified research workers who have problems of significance should be given aid in the amounts that their work may demand for its effective prosecution. They may need funds for travel to distant sources of data; they may need tabulating and calculating machines and skilled operators; they may need the services of research mathematicians or of consulting statisticians to design experiments or to work out new mathematical procedures appropriate to their problems; or they may need the full-time cooperation of other social scientists throughout the study. Universities may have to be reimbursed if occasionally a faculty member takes off full time for the prosecution of research. These personally directed projects will call for, let us say, from $1,000 to $15,000 per year in each case. How many persons could use this aid in a year? We do not know in advance of trial, but if pressed for an answer, we should note that there are approximately 900 colleges, teachers colleges, and universities in the country. At least one faculty member in every third institution would have a research bent and sufficient perspective to be ready to attack, to the advantage of our society, several problems in succession.

A rough total can be obtained from the foregoing suggestions. The maximum called for in the outline would be about $9,000,000; the bare minimum, around $1,000,000. The minimum of *both* numbers and amounts, however, would be much less than a satisfactory figure, even for a minimum estimate. If these amounts seem large, they are small in comparison with the amounts spent for physical research, either by the Government during the war or by industry in any year. In fact, the maximum estimate is less than the average amount by which American industry *increased* its research expenditures each year over the period from 1920 to 1940.[5] A real question may be raised as to whether it is sound policy to operate a public enterprise as large as the school system, costing between $2,000,000,000 and $3,000,000,000 a year, with so small an expenditure for research to regulate and guide it. The maximum estimate suggested above is 0.5 per cent of this operating expenditure.

---

[4] In the 1930's the U. S. Office of Education was allotted over $2,500,000 for five projects, and other undertakings were given from $500,000 to $1,000,000 each. See Carter V. Good, Educational progress during the past year (1937). *Sch. & Soc.*, 1938, 47, 345–352.

[5] Obtained from Table I, p. 80, of Vannevar Bush. *Science, the endless frontier: a report to the President.* Washington, D. C.: U. S. Government Printing Office, 1945. Estimates of Federal support needed for physical research were set at $122,000,000 for a mature program (p. 33).

The lay person may inquire: "What will you study, aside from trying to improve methods of teaching spelling, reading, and so on? All of us got enough of these to get along in life somehow." This type of question has been asked countless times by practical people with respect to the physical and biological sciences during their history; it reflects simply an utter lack of understanding of science and its basic contributions. So long as nobody had ever thought of steel, iron workers wondered what physics or chemistry was good for. Before the atomic bomb, only physicists thought in terms of nuclear energy. Before medicine and public health measures had added 20 years to our lives, people thought that biological science was just a course to be taken in high school. Only persons of great vision know the future.

This is not the place for a listing of fundamental problems in education. Some have been suggested earlier. Reference to the *Encyclopedia of Educational Research* or a volume of the *Review of Educational Research* will make their nature and number apparent. It may be noted here simply that education is closely related to the total success of any civilization and of any world order. The fanaticism of the Japanese and the Nazis was the product of carefully planned education. What is taught in the schools eventually determines the character and organization of the world in which we live. In this country, the curriculum and the objectives of education are, according to a democratic pattern, largely determined locally, and usually by educators. A large responsibility rests on their shoulders, and they need the findings of extensive research to guide them in their choice of materials, methods, and objectives which will help bring into reality the sort of world that exists in the hopes of the common man everywhere. It is for the purpose of enabling the schools to fulfill their obligation to a society ever struggling toward cherished, but constantly expanding, goals that educational research seeks a new pattern of support. As research workers, we speak, not for ourselves, and not primarily for our work, but for a social world better adjusted to the aspirations and satisfactions of man. We speak from the conviction that genuine progress toward this goal will come not through physical force alone, but through the far-reaching power of psychological force channeled through the social institution of education.[6]

---

[6] The opportunity for all science to work together toward "a science of civilization" is presented by Ward Shepard in "Science for democracy" (*Science*, 1946, 103, 65–68).

Scanning Science—

The Editor of *Science*: Last Wednesday, May 6th, I witnessed a very remarkable experiment with Prof. Langley's aerodrome on the Potomac River; indeed, it seemed to me that the experiment was of such historical importance that it should be made public.

I am not at liberty to give an account of all the details, but the main facts I have Prof. Langley's consent for giving you, and they are as follows:

The aerodrome, or "flying machine" in question, was of steel, driven by a steam engine. It resembled an enormous bird, soaring in the air with extreme regularity in large curves, sweeping steadily upward in a spiral path, the spirals with a diameter of perhaps 100 yards, until it reached a height of about 100 feet in the air at the end of a course of about half a mile, when the steam gave out, the propellers which had moved it stopped, and then, to my further surprise, the whole, instead of tumbling down, settled as slowly and gracefully as it is possible for any bird to do, touched the water without any damage, and was immediately picked out and ready to be tried again.

A second trial was like the first, except that the machine went in a different direction, moving in one continuous gentle ascent as it swung around in circles, like a great soaring bird. At one time it seemed to be in danger as its course carried it over a neighboring wooded promontory, but apprehension was immediately allayed as it passed 25 or 30 feet above the tops of the highest trees there, and ascending still further its steam finally gave out again, and it settled into the waters of the river, not quite a quarter of a mile from the point at which it arose.

No one could have witnessed these experiments without being convinced that the practicability of mechanical flight had been demonstrated.

Yours very truly,
Alexander Graham Bell

—22 May 1896

Science and Life in the World

George Westinghouse Educational Foundation Forum, 16-18 May

THE GEORGE WESTINGHOUSE EDUCATIONAL FOUNDATION sponsored a three-day forum, in observance of the centennial anniversary of the birth of the founder of the Foundation, in Pittsburgh, 16–18 May. The general theme of the forum was: "Science and Life in the World."

The opening session, entitled "Science and Civilization," was addressed by A. V. Hill, foreign secretary of the Royal Society, London, who spoke on "Scientific Ethics." He called attention to the fact that "some might believe that it was a sign of approaching old age to have chosen 'Scientific Ethics' for a topic instead of something more practical and up to date," but he felt that all scientists, young and old, are really deeply concerned about ethics, whether they know it or not. He made his hearers feel that students of a scientific ethic have a definite advantage over the champions of other ethical systems in the universal cogency of scientific methods and results. "All sensible men everywhere finally agree about the facts; race, religion, and political opinion have no bearing at all on them or their interpretation," he concluded.

Prof. Hill went on to say:

> To a cynical observer of the recent behavior of *homo sapiens* these moral reflections may sound naive: I admit that I often feel skeptical, myself, about the outcome. But there seems to be no alternative: We scientists throughout the world must take the initiative in these matters. We must not leave it to others who will certainly do nothing about it. If we do, we and our civilization may perish together.
>
> We in England have recently watched with admiration the example of strong and courageous initiative taken by certain American scientists in refusing to be coerced and conscripted against their conscience: I say to you, the same determination exists elsewhere. As free men we are all unwilling to be used as pawns in the game of international power politics: to consent in advance to the exploitation of science for secret purposes that we may not approve.

He spoke sympathetically of the Acheson Report (*Science*, 1946, **103**, 451), calling it a "notable example of the mixture of hard common-sense and practical idealism which is typical of America at its best."

In considering the subject of international control he pointed out that atomic explosions are not the only means by which a future aggressor might attempt to dominate the world. "Microbiologists," he said, "might make themselves as great international nuisances as physicists, with less danger, perhaps, of being found out in time."

Isaiah Bowman, president of Johns Hopkins University, spoke during the same session on "Social Composition of Scientific Power." "We shall not easily accomplish the ends of the United Nations," he said.

"Men say that world cooperation will surely work now because the swift communications of science have so obviously brought the world together." But he regretted that "our togetherness is an affair of copper wire," airplanes, and radio—technology—"rather than an affair of recognized universals of spirit and ideals."

"Our views," he held, "are no less bounded because we travel around the world swiftly, or talk to it on the instant." Even if "geographical highways" are open, psychological barriers remain.

Dr. Bowman concluded his analysis of the social composition of scientific power by saying:

> Facing the raw facts of today's world we see a special role for science. If it is not yet in the area of free discussion the world around, its tendency is unremittingly international. Discussion under free conditions will help reduce the most refractory difficulties. It has been said that government, by discussion, ''broke the bond of ages and set free the originality of mankind.'' Parliaments rather than dictators; free speech rather than ''party line''; rising standards of living to which applied science contributes powerfully; a striving for peace rather than a striving for confusion supported by a stimulated fear of war—these are some of the building blocks of our future ''good life.'' Among the agencies of construction are all forms of learning, including science.

George W. Merck, president of Merck and Company, spoke realistically, factually, of biological methods of offensive and defensive warfare. He said that "in the fall of 1941 opinion in the United States regarding the possibility of biological warfare was not uninformed," but that "common prudence dictated a serious consideration of the dangers of possible attack along these lines."

"The President," he revealed, "directed an initiation of an extensive large-scale investigation of the possibilities and potentialities of biological warfare in the United States and the establishment of active collaboration with the British and Canadians." These objectives, he said, were attained, and "defenses against the potentially dangerous biological attack were devised so that there was no possibility of surprise from this quarter."

He also said that, "while biological warfare was not actually used in military operations in World War II, enough was discovered to make it imperative that those responsible for our national welfare be ever on the alert in the future."

He related that "at the height of its development, the Special Projects Division of the Chemical Warfare Service of the Army, which carried the main responsibility for the biological warfare program, had a personnel of 3,900. In addition, the Navy had a separate group of nearly 100 at work on a special phase of the problem. The work of these groups, and that done in the universities, research institutes, and industries, represented a truly combined operation in which Army, Navy, civilian personnel, and allied teams worked together in the closest cooperation."

The following principal accomplishments were revealed:

1. *Methods and facilities for the mass production of pathogenic microorganisms and their products were developed.* Offensively, methods were discovered for making microorganisms as virulent as possible and for maintenance of virulence under different conditions of storage for different lengths of time. Defensively, new methods for protection of personnel, animals, and plants against these virulent strains were perfected.

2. *Methods for the rapid and accurate detection of minute quantities of disease-producing agents were elaborated.* These defenses, he held, will be of value in peacetime work in laboratories, hospitals, and industries.

3. *Significant contributions were made to the knowledge of the properties and behavior of air-borne, disease-producing agents.*

4. *A pure, crystallin, bacterial toxin was isolated and studied for the first time.* This was the toxin of *Clostridium botulinum*, Type A, which, he said, "is the most potent biological poison known to man" (*Science*, 1946, **103**, 613).

5. *Vaccines for the protection of chickens against two highly fatal diseases known as Newcastle disease and Fowl Plague.* Chickens are an important source of food for human beings.

6. *Large-scale tests of a vaccine for the protection of cattle against rinderpest, a fatal Oriental disease, were made.*

7. *Extensive studies were made on the production and control of diseases which might affect crops of economic importance.*

8. *Information was obtained regarding the effect of more than 1,000 different chemical agents on living plants* (*Science*, 1946, **103**, 469). This is a particularly fertile field that promises much to agriculture in terms of selective plant control agents, but, he said, "the work was initiated to find destructive agents against various crops and was successful." Only the rapid ending of hostilities prevented field trials in an active theater of war.

The most immediate peacetime benefit from all of this war work will be the administration, through the agency of UNRRA, of surplus rinderpest vaccine to cattle in China, where rinderpest is a disease of great importance for the survival of the Chinese who depend on cattle for food and transportation.

At a luncheon session L. W. Chubb, director of Westinghouse Research Laboratories, spoke on "Partners in Science." He made the point that the slow methods of technological application of the past, typified by Watt and his teakettle and by Goodyear and his kitchen stove, have given way to highly specialized teams requiring great skill on the part of the individual members and long periods of training in the operations involved.

He paid tribute to the first of these partners—the scientists who are producers of new knowledge subsequently applied in industrial pursuits: he spoke of these workers as being located predominantly in the universities, where they are motivated principally by the desire for new knowledge, having in mind no immediate technological application of their work.

Dr. Chubb felt that the second "partner in science" is the inventor who suggests practical uses, new combinations, and pertinent applications of abstract knowledge passed on by the first partners.

The third partner, he said, is the engineer who develops and designs new products and processes.

He pointed out that these partnership functions need not be separated but may, occasionally, be integrated in one person, although this rarely happens. He said:

> Popular opinion has put science in the saddle for several reasons. In the first place, each group of partners in science likes to think that its contribution is the most important, and I believe that the scientists and scientific journals were not at all backward in reporting their accomplishments. Then, popular reporting of scientific work is more newsy than the more prosaic work done by engineers. Finally, the most glamorous accomplishments, such as radar, the atomic bomb, and the proximity fuse, are applications of scientific knowledge more recently acquired, and they are credited mostly to the scientists, particularly physicists and chemists, who in special groups actually carried on the development. Probably well over 95 per cent of the activity on these glamorous items consisted of engineering and production. All of them were applications of prewar scientific knowledge. Although a great amount of specific research had to be done, most of the work of the scientists was invention and engineering development, and these are activities quite outside of their usual field.

He continued: "There is a general feeling that during the war a great amount of fundamental scientific work was done, and that the store of basic knowledge is full to overflowing. This, unfortunately, is not the case, because workers in pure science were taken from their usual pioneering activities and used to solve pressing war problems in industrial research, invention, and engineering development."

Now that the war is over, he said, "we need to revert to the usual sequence of technological development proven by past experience"—research scientists and professors should go back to the universities to do their chosen work in fundamental research and the training of men to carry on in industry."

In the afternoon session, "The Future of Atomic Energy," Frank B. Jewett, presiding, Robert J. Oppenheimer opened with a short address on "Atomic Explosives." One gathered that Dr. Oppenheimer was not interested in explosions, whether they were "atomic" or not.

The use of nuclear energy in warfare, he thought, should definitely be barred, but not all applications should come under the ban.

Complications come because there are perfectly legitimate ways to employ our new-found knowledge of nuclear physics. These methods need some kind of authority to guide us in applying them. At this time, he said, there is "no authority for prohibiting anything" as far as international relations are concerned.

In this connection, he spoke of his belief that the Acheson-Lilienthal Report (Science, 1946, **103**, 451) offered the best solution for "making use of those differences in the requirements of fissionable materials for employment in reactors as opposed to atomic explosives."

Enrico Fermi, professor of physics, University of Chicago, spoke at a later time on the uses of nuclear energy for power. He pointed out that mobile units smaller than our largest locomotives are not likely, even though the weight of the "fuel" is negligible. Massive shielding to protect operators or even casual human visitors against biologically harmful radiations is a present requirement, he said.

Speaking on the biological phase, W. Edward Chamberlain, professor of roentgenology and radiology, Temple University School of Medicine, held that the shift in emphasis from morphology to function among biologists was in part, anyway, stimulated by the discovery of the X-ray, which permitted fluoroscopic observations of function, and that the trend in this direction is now being stimulated by the availability of biological tracers and therapeutic agents manufactured in conjunction with chain-reaction piles, cyclotrons, and betatrons. He spoke in some detail on the variety of radioactive isotopes and especially of radioactive iodine in the diagnosis of pathology of the thyroid gland.

He pointed out that "therapy with radioactive isotopes is definitely a two-edged sword" and that safe procedures must be supervised by people with adequate knowledge and experience. He also felt that supervision was going to be very difficult as radioactive materials become more generally available. As one listened to his account of early X-ray abuse by the pioneers and the poorly informed, he felt that Dr. Chamberlain was warning against a too enthusiastic and misinformed use of radioactive isotopes.

In concluding, Dr. Chamberlain said that "from the point of view of biology and medicine, a truly brilliant future can be predicted for atomic energy, provided its potentialities as an explosive do not lead to the total destruction of our civilization."

He went on to say: "If the greatest of physicists, chemists, and engineers can be brought together for the enterprise that made a place in history for Los Alamos, why cannot the greatest men in the fields of psychology, psychiatry, human history, and social technics be similarly brought together?"

Hugh S. Taylor, dean of the Graduate School, Princeton, spoke at this same session on the numerous chemical applications of the radioactive isotopes which now for the first time can be produced in sufficient quantities. The nuclear reactor, unlike the cyclotron, can produce useful quantities of these important tracers and possible therapeutic agents.

At the dinner session on 16 May Vannevar Bush, director of the Office of Scientific Research and Development and president of the Carnegie Institution of Washington, spoke on "Planning in Science." Excerpts from his address follow:

> Do not mistake me, however, as blandly joining the chorus which is bewitched by the magic of the word ''science'' and sings an ill-considered and often cloying paean of praise to something summarily referred to as ''the scientific method.'' I am decidedly not one of those who speak of the scientific method as a firm and clearly defined concept and who regard it as a mystical panacea immediately applicable to any trouble and immediately productive of complete cure. Of course, there is a system of approach to specific problems which we know as the scientific method—an orderly sequence of hypothesis and analysis which, by a series of approximations and tests, culminates in a practicable theory of operation. But to give this name of ''scientific method'' to mental operations involving no more than the use of common sense, or indeed to operations which are no more than rigorous logical thinking, is a mistake. I therefore wish not to be taken as joining those who facilely argue that all we need to do to settle any difficulty is apply the scientific method to it. Nor do I wish to imply that the greater frequency which I foresee for direct intellectual contribution by scientists to our national life will consist principally in attempts to carry over into public forums, legislative committee rooms, and industrial plants a specialized technique of thinking, admittedly very effective but admittedly also best suited to the laboratory and the study.

The second day opened with a session devoted to the general topic, "Transportation—A Measurement of Civilization." Edward Warner, president of the Interim Council, Provisional International Civil Aviation Organization, spoke on the aviation phase.

He said that there was no guarantee that the airplane will actually improve the world, but that it has three characteristics which give it value: (1) It gives more rapid transportation than is available by any other means; (2) it can go directly from one point to another; and (3) rising, as it does, to great heights, it can give an otherwise unattainable vantage point for observation of the terrain. All of the uses to which aircraft are put arise out of some combination of these three properties. To get men together quickly may result in their quarreling, and whether or not they are going to quarrel in the future or arrive at some amicable settlement for their differences depends, the speaker said, on an understanding of the "realm of human relations." Dr. Warner said that the use of the airplane for transportation, although not limited completely to organized airlines, still, even in the future, will consist of 80 to 90 per cent of the common carrier type; and although there will be a great increase in the actual number of private planes in the United States, these will not bulk large in the percentage of total air travel.

He felt that the romantic appeal of intercontinental flight overshadows the more prosaic business of carrying day-by-day passengers between near-by points. On the airways as on the highway most travel is between adjacent points. He pointed out that, although it has been suggested that the airplane will be a factor in the enlargement of commuting areas around large cities from the present 30 or 40 miles to 100 or 200 miles, flights of this kind are still too expensive, a monthly commuting ticket costing about $200 at present rates.

In the field of international relations we run into the now familiar culture lag. In this case it seemed to the speaker a strange anomaly that, 40 years ago, crossing the Atlantic required a week, while preparation for the trip took no longer than the time required to pack a suitcase, get a ticket, and pay the fare; whereas, at the present time, when the Atlantic can be crossed in less than 12 hours, it is the very fortunate traveler who can make his way through all of the barricades of passport and visa requirements, tax receipts, and currency authorizations in less than a week of preparatory activity. The International Civilian Air Organization has to consider, among other things, the simplification of these international barriers to travel. This group believes that a passenger should not be delayed any more than 15 minutes between the time the airplane touches the ground and the time the passenger is free to leave the port, and that a similar reasonable criterion should be applied to express shipments. The ultimate effect of international air travel will be to break down international boundaries.

The PICAO plans a series of demonstrations of current work on air-navigation aids in the United States during this summer and will then proceed to a meeting in Montreal in September, at which it is hoped that standard systems and equipment for immediate installation can be agreed upon.

A problem for the future concerns the adaptation of radar equipment so that the pilot will himself be aware of obstacles and other aircraft instead of having to depend on radio contact with the ground station to avoid these hazards as he does today. Dr. Warner believed that it is inevitable that, step by step, the quality of air transport service will improve during the next half century and that it will become more reliable and more economical. "It will assume increasing status as a major element in the world's transportation systems. As it does, it will present new problems of organization and new problems of political and economic relationship among the nations. In its growth, it ought indeed to be a civilizing force."

Marine and rail transportation were treated by Adm. Emory S. Land, former chairman, U. S. Maritime Commission, and Martin W. Clement, president, Pennsylvania Railroad. Charles F. Kettering, general manager, General Motors Research Laboratories and chairman of the executive committee, AAAS, who was to have spoken on automotive transportation, was unable to be present, but his paper was read by A. L. Boegehold, director of the Metallurgical Department of the Research Laboratories of General Motors.

The luncheon session was addressed by Frank B. Jewett, president of the National Academy of Sciences, who spoke on "Horizons in Communications."

In the afternoon session there was a symposium on biological science, at which Cornelis B. van Niel, professor of microbiology, Stanford University, spoke on phytosynthesis, and Selman A. Waksman, professor of microbiology, Rutgers University, and discoverer of streptomycin, outlined our present understanding of microorganisms with special reference to those that are known to be either harmful or beneficial to man. Two other speakers treated biological groundwork: Linus Pauling, California Institute of Technology, spoke on "Molecular Architecture and Biological Reaction," and George W. Beadle, Stanford University, treated "High-frequency Radiation and the Gene."

The Friday evening session followed a dinner at 7:00 o'clock in the ball room of the Hotel Schenley. There were two addresses: Charles W. Kellogg, president of the Edison Institute, spoke on "Electric Power—The Foundation of Industrial Empire," and Karl T. Compton, president, Massachusetts Institute of Technology, spoke on "Scientific and Engineering Progress—Insurance Against Aggression and Depression."

Mr. Kellogg noted that every industrial worker has the equivalent of seven horsepower of electric energy available to him, and that the electrical horsepower per man in industry grew 58 per cent in the 15-year period from 1929 to 1944. The productiveness of the individual worker is high as a result, and he can be paid more. According to Mr. Kellogg, "real wages of workers in industry grew 63 per cent in the same 15-year period." He also pointed out that workers earn, in different countries, an amount which bears a close relation to the mechanical horsepower available in these countries.

He pointed out that the first central generating station built by Thomas A. Edison in 1882 was conceived of as a means of making a filament of an electric lamp burn; the early "electric" companies were really "lighting" companies, as their names attested.

> With the growth in the load on these first central stations, the use of electricity for power as well as light and the constantly increasing distance of the load from the central station, the industry encountered difficulties with transmission and distribution. With the relatively low voltage at which the direct current had to be generated for safe use by customers, substantial load growth meant either a fabulous investment in copper conductors or the necessity for many relatively small generating stations or both. This dilemma was solved by George Westinghouse, through the development of the alternating current system, which is used throughout the world today.
>
> In 1890, Westinghouse built a small 100-horsepower, single-phase, alternating-current plant at Telluride, Colorado. The voltage was 3,000 and the transmission distance was only three miles, but the amount of copper required for the transmission line was very small compared to that needed by the direct-current plant proposed by Edison in competition. The success of this plant led to the adoption of alternating current for the first Niagara Falls plant, where Westinghouse installed three 5,000-horsepower polyphase, alternating-current generators in 1893. These machines are the forerunners of modern hydroelectric generators of well over 100,000 horsepower.
>
> Looking back now it is easy to see that, without the alternating-current system, the size and scope of our present-day electric power systems would be quite unthinkable. The development of the years has shown the greatest economy to result from generation in large stations. Without alternating current, and consequent high voltage for transmission, it would be impossible to carry the power away from such large stations. With the direct conveyance of power through the heaviest leather belt, travelling a mile a minute, it would require a belt nearly two-thirds of a mile wide to transmit the output from the largest modern station; but with alternating current at 220,000 volts this power can be safely carried away over three wires the size of your thumb.
>
> In distribution throughout even urban areas, the beneficial effect of alternating current still goes marching on. At the turn of the century the high-voltage distribution about cities was at 2,200 volts. This involved only 1/100 the line loss that would occur with 220 volts, but when, with the passage of time, loads became too heavy to be carried satisfactorily at 2,200 volts, substations, fed by 13,200 volt lines, were dotted about the city. Now, normal distribution is itself being stepped up to 13,200 volts, with no loss in safety, with a further cut of 36-fold in line losses and the consequent ability to improve voltage regulation and to eliminate countless substances.

Dr. Compton pointed out that although the Government has called on scientists in every great emergency since the Civil War, the period between wars has been almost wholly without governmental support or recognition. In speaking about the present legislation before Congress concerning an Atomic Energy Commission, he said that, "It will be a catastrophe and a disgrace and will leave the country in a period of doldrums," if Congress should fail to pass adequate legislation at this session.

One of the objectives of the National Science Foundation legislation is to provide for, "a great program of scholarships or fellowships in order that the scientific talent inherent in the population may have full opportunity for education and demonstration, and that the deficiency in scientifically trained personnel created by our policies during the past war may be eliminated." Without this provision, "laboratories will be only a delusion and a waste of money, and factories will before long become obsolete."

He pointed out that labor has nothing to fear from science and that "labor has its stake" in scientific progress just as the public has.

On Friday the staff of the Buhl Planetarium and Institute of Popular Science offered two programs as alternates to the regular sessions. Both of these popular treatments were well attended by the registrants.

Saturday morning was spent in a trip through the Mellon Institute of Industrial Research under the guidance of its director, Edward R. Weidlein, who has been on its staff in several different capacities for the last 34 years.

Technical Papers

The Structure and Synthesis of the Liver *L. casei* Factor

Robert B. Angier, James H. Boothe, Brian L. Hutchings, John H. Mowat, Joseph Semb, E. L. R. Stokstad, Y. SubbaRow, and Coy W. Waller

Lederle Laboratories, Inc., Pearl River, New York

Donna B. Cosulich, M. J. Fahrenbach, M. E. Hultquist, Erwin Kuh, E. H. Northey, Doris R. Seeger, J. P. Sickels, and James M. Smith, Jr.

Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey

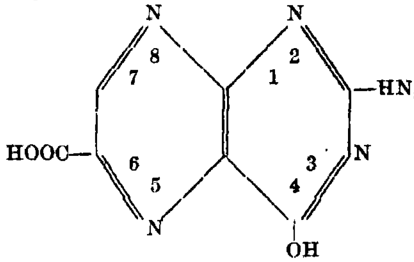
Several compounds have been described which are essential for the growth of *Lactobacillus casei* and which possess hematopoietic activity for animals. One of these compounds was isolated from liver and has been designated the liver *L. casei* factor (*5*). Another form of the compound was isolated from a fermentation product and has been termed the fermentation *L. casei* factor (*3*).

The purpose of this communication is to describe the degradation reactions used to characterize the liver *L. casei* factor and to present two methods of synthesis.

The relationship between the fermentation and the liver *L. casei* factors was shown by anaerobic alkaline hydrolysis which converted the fermentation compound into the dl-liver *L. casei* factor with the simultaneous formation of two moles of a compound which contained alpha-amino acid nitrogen.

On aerobic alkaline hydrolysis of the fermentation *L. casei* factor two fractions appeared to be formed in equimolar amounts, one of which was highly fluorescent while the other fraction gave a positive test for an aromatic amine, using the method of Bratton and Marshall (*2*).

The fluorescent compound was a dibasic acid having pKa values of 3.9 and 7.7. On heating the compound to 300° C., carbon dioxide was evolved, and the resulting product was a monobasic acid having a pKa of 8.0. These data indicate the presence of a monocarboxylic acid. Oxidation of the original compound with chlorine water, followed by hydrolysis with 0.1 N hydrochloric acid gave a positive test for guanidine. The ultraviolet absorption spectrum, fluorescence, empirical formula, and the formation of guanidine indicated the presence of a 2-amino pteridine containing a hydroxy and a carboxylic acid group. This substance was identified by comparison with a synthetic compound as a pteridine having the following structure:



(I)

2-amino-4-hydroxypteridine-6-carboxylic acid

This compound was synthesized by chlorination with phosphorus pentachloride and reduction with hydrogen iodide of 2-amino-4,7-dihydroxypteridine-6-carboxylic acid (*4*). Evidence for the selective chlorination and reduction of the 7-hydroxy group was obtained by decarboxylation of compound (1) and the identification of the product as 2-amino-4-hydroxypteridine by comparison with a compound which was synthesized from 2,4,5-triamino-6-hydroxypyrimidine and glyoxal.

This 2-amino-4-hydroxypteridine-6-carboxylic acid can also be prepared from the corresponding 6-methyl or 6-acetic acid compound, or from the *N*–[(2-amino-4-hydroxy-6-pteridyl)methyl] pyridinium iodide by oxidation with hot alkaline potassium permanganate. These compounds are described elsewhere in this paper.

After acid hydrolysis of the aromatic amine fraction, a compound was isolated and identified as *p*-aminobenzoic acid.

Sulfurous acid cleavage of the fermentation *L. casei* factor gave a pteridine fraction and an aromatic amine. The pteridine fraction reacted rapidly with aldehyde reagents to give insoluble derivatives, which indicated the presence of a carbonyl group. The aldehyde, on standing with dilute alkali in the absence of oxygen, appears to undergo a Cannizzaro-type reaction to yield the previously described 2-amino-4-hydroxypteridine-6-carboxylic acid and another pteridine, which has been identified as 2-amino-4-hydroxy-6-methylpteridine by comparison with an authentic sample prepared by decarboxylation of 2-amino-4-hydroxy-6-pteridineacetic acid. This latter compound was prepared by the condensation of 2,4,5-triamino-6-hydroxypyrimidine and methyl γ,γ-dimethoxyacetoacetate.

Final proof that the methyl group of 2-amino-4-hydroxy-6-methyl-pteridine was in the 6-position was obtained by degradation of the compound by the method of Weijlard, Tishler, and Erickson (6). The resulting product was compared with an authentic sample of 2-amino-5-methylpyrazine and found to be identical.

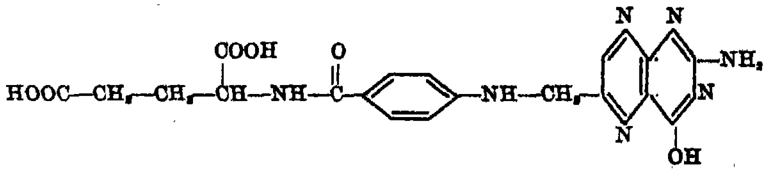
Acid hydrolysis of the amine fraction liberated 75 per cent of the nitrogen as alpha-amino acid nitrogen. From these acid hydrolysates *p*-aminobenzoic acid was isolated and characterized, and by microbiological assay the presence of three moles of glutamic acid was indicated. The presence of the glutamic acid was further substantiated by isolation of pyrrolidonecarboxylic acid from aqueous hydrolysates of the fermentation *L. casei* factor.

No significant amounts of fragments containing one or two carbon atoms could be detected in aerobic alkali or sulfurous-acid-cleaved fractions of the *L. casei* factor.

The parallel liberation of the aromatic amine and the pteridine indicated that the pteridine was attached to the amino group of the *p*-aminobenzoic acid. Since no pteridines containing more than one carbon atom in the side chain could be isolated and since there was no evidence for the existence of one or two carbon atom fragments in the hydrolysis mixtures, a one-carbon atom linkage was indicated. The necessity of oxygen for the alkaline cleavage of the *L. casei* factor suggested the presence of a methylene group. This hypothesis was further strengthened by the fact that the cleavage of *N*-benzyl-*p*-aminobenzoic acid with alkali was accelerated by the presence of oxygen.

The presence of a peptide linkage between *p*-aminobenzoic acid and glutamic acid was obvious from the liberation of alpha-amino acid nitrogen by hydrolysis of the amine fragment.

From a consideration of the above evidence, the structure indicated below was postulated for the liver *L. casei* factor.



N—[4—{[(2-amino-4-hydroxy-6-pteridyl)methyl]amino}benzoyl]glutamic acid

The structure of the fermentation *L. casei* factor will be discussed in a subsequent communication.

Proof of the above structure was afforded by two methods of synthesis:

(1) The first method consisted of reacting equal molecular amounts of 2,4,5-triamino-6-hydroxypyrimidine, *p*-aminobenzoyl-*l* (+)-glutamic acid, and 2,3-dibromopropionaldehyde in the presence of an acetate buffer. The resulting crude product contained about 15 per cent by weight of the active compound as determined by microbiological assay. The condensation first gave a dihydro derivative which, during the course of the reaction, was transformed into the aromatic compound.

Purification of the active material was effected by the following procedure: The crude material was dissolved at a concentration equivalent to 400 µg. of the active compound/ml. in 0.2 N sodium hydroxide. Solid barium chloride was added to 0.2 N, and ethanol was added to a concentration of 20 per cent by volume. The precipitate was discarded. The solution was freed of barium, diluted to a concentration equivalent to 100 µg. of the active compound/ml., and adjusted to pH 7.0. The resulting precipitate was discarded and the solution was then extracted three times with 10 volume portions of butanol. The aqueous phase was concentrated to a volume equivalent to a concentration of 400 µg./ml. The solution was adjusted to pH 3.0, chilled to 0°–5° C., and the precipitate was collected. This precipitate was dissolved in 0.1 N sodium hydroxide at a concentration equivalent to 200 µg./ml. and treated with charcoal to remove any residual brown pigments. After filtration, the solution was adjusted to pH 3.0 and the active compound crystallized from hot water. This product had the physical and biological properties described in a previous publication (*1*).

(2) The second method of synthesis was carried out by reacting 2,3-dibromopropionaldehyde with pyridine and then condensing this product with 2,4,5-triamino-6-hydroxypyrimidine and potassium iodide to give *N*-[(2-amino-4-hydroxy-6-pteridyl)methyl] pyridinium iodide. This compound was then reacted with p-aminobenzoyl-*l* (+)-glutamic acid and sodium methoxide in ethylene glycol at 140° C. to give a crude product containing about 15 per cent of the biologically active material. The active compound was purified as described above and was identical with the compound prepared by the first procedure.

By the same methods of synthesis, using *p*-aminobenzoic acid instead of *p*-aminobenzoyl-*l* (+)-glutamic acid, a compound was obtained which was active for *Streptococcus faecalis* R but inactive for *L. casei* and the chick.

For the compounds formed from *p*-aminobenzoic acid and *p*-aminobenzoyl-*l* (+)-glutamic acid, the names pteroic acid and pteroylglutamic acid are suggested.

References

1. Angier, R. B., *et al.* *Science*, 1945, **102**, 227.
2. Bratton, A. C., and Marshall, E. K. *J. biol. Chem.*, 1939, **128**, 537.
3. Hutchings, B. L., Stokstad, E. L. R., Bohonos, N., and Sloane, N. H. *Science*, 1944, **99**, 371.
4. Purrmann, R. *Ann.*, 1941, **546**, 284.
5. Stokstad, E. L. R. *J. biol. Chem.*, 1943, **149**, 573.
6. Weijlard, J., Tishler, M., and Erickson, A. E. *J. Amer. chem. Soc.*, 1945, **67**, 802.

Famine Edema and the Mechanism of Its Formation[1]

Ancel Keys, Henry Longstreet Taylor,
Olaf Mickelsen, and Austin Henschel
Laboratory of Physiological Hygiene, University of Minnesota

Edema associated with severe undernutrition was widespread in Europe during and shortly after World War I. No adequate explanation from infectious, cardiac, or renal causes was found. Speculation as to the mechanism of formation of this edema subsided with the demonstration that edema can be provoked in animals by a very low protein diet and with the accumulation of evidence for the general validity of Starling's concept of a filtration balance between hydrostatic and colloid osmotic pressures at the capillary wall. Despite some puzzling facts (*10–12*), by the eve of World War II there was almost universal agreement that "famine edema," as in kidney disease, is produced by a profound depression of the plasma colloid osmotic pressure, this in turn being a result of inadequate dietary protein.

In World War II, as expected, famine edema again appeared on a large scale. Contrary to expectation, however, the theory of simple hypoproteinemic causation was not fully sustained in such observations as were made (*4, 7*), though there was reluctance to abandon entirely this attractive theory (*1, 5, 6, 9*). Data gathered by the Allied Armies indicated that hypoproteinemia was common in famine areas but that it was generally slight in degree and was not closely related to the appearance or severity of edema (*3, 13*).

In this laboratory data were obtained from a controlled experiment with 34 men (volunteers from civilian public service), who subsisted on a European type of famine diet for six months preceded by a control period of three months and followed by three months of controlled "relief" feeding. The diet of whole cereals, potatoes, turnips, etc. provided an average of 49 grams of protein daily and proved to be closely similar to the diets in the less fortunate parts of western Europe in early 1945. These men lost an average of 24.5 per cent of their body weight. Pitting edema appeared within two months in some of the men and eventually in all but a few of the group; even the few apparent exceptions were shown, by special means, to be "waterlogged." At the end of semistarvation the thiocyanate method indicated an average SCN^- space of 34.0 per cent of the total body weight and a relative excess of 7.19 kg. (15.9 lbs.) of extracellular water per man. In proportion to the non-SCN^- space, the extracellular water rose from a "normal" average of 282 grams/kg. of cellular tissue to a "starvation" average of 554 grams/kg.

This development of edema was accompanied by only a small decline in plasma protein concentration, averaging 0.73 grams/100 cc. At the same time the ratio of albumin to globulin decreased to only a trivial extent. Independent analyses by the Tiselius electrophoresis method (veronal buffer) gave an average A/G of 2.00 for the heparinized plasmas of six men who showed marked edema. The same method, when applied to serum, gave A/G values of 1.70 and 1.89 for two of these men. Heparin has a slight influence on the Tiselius pattern which will be reported subsequently.

Clinical edema vanished during three months of refeeding which produced an average recovery of 37 per cent of the lost weight. At the same time the plasma protein concentration returned to normal, but there was a slight fall in A/G; by the Tiselius method A/G averaged 1.82 in the heparinized plasmas of the six men mentioned above. Clearly, the edema was not explicable in terms of hypoproteinemia or subnormal colloid osmotic pressure in the plasma, even with "correction" for protein in the interstitial fluid; edema fluid in this condition is extremely low in protein.

These subjects, like the victims abroad, showed a marked polyuria, profound bradycardia, and no rise in the concentrations of nonprotein nitrogen and chloride in the plasma. The liver was not palpable, and the heart was much diminished in size by X-ray examination. Thiamine deficiency was definitely ruled out by the analysis of food and excreta for thiamine, the reduced size of the heart, and by the absence of signs of polyneuritis. Direct measurements of venous pressure showed that, instead of an increase, there was a markedly subnormal level. At the end of semi-

---

[1] This work was supported in part under the terms of a contract, recommended by the Committee on Medical Research, between the University of Minnesota and the Office of Scientific Research and Development. Substantial support was provided by the John and Mary R. Markle Foundation, the Sugar Research Foundation, the National Dairy Council, the Service Committees of the Church of the Brethren and of the Society of Friends of the Unitarian Society, and the Mennonites Central Committee. More complete acknowledgments will be made in future full publications on this experiment.

starvation the mean supine venous pressure in 32 men was 4.80 cm. of saline solution with the needle in an arm vein and the manometer zero at 10 cm. above the table level. Control measurements on 12 normal men gave averages of 9.7 and 10.3 cm. on two occasions five months apart. Data on two of the subjects who showed only moderate clinical edema after six months of semistarvation are given in Table 1. During refeeding, the venous pressure gradually rose to normal values.

TABLE 1

	Body wt. (kg.)			SCN· Space		Plasma Prot.		Ven. Press. Cm.
Subject No.	Control	Starv.	Diff.	% Wt.	Edema* Kg.	Grams/100 cc.	A/G	Saline
109	79.3	59.5	− 19.8	31.0	5.4	6.44	1.79	4.8
112	61.4	49.0	− 12.4	32.3	5.0	6.78	2.01	4.5

* The figure for "edema" represents the excess extracellular water as calculated from the proportion in the normal state.

The more prominent factors in the Starling concept of edema formation would not seem to explain famine edema unless we accept the unlikely hypothesis of a remarkable hydrostatic pressure gradient between the capillary and the larger veins. Parenthetically, it may be noted that there was a moderate arterial hypotension at both systole and diastole. Of the items in the Starling equation as elaborated by Schade and Claussen, Krogh, and others, there remains only the tissue pressure. Youmans, *et al.* (*12*) emphasized this neglected factor in their attempt to explain endemic edema in Tennessee, but their calculations as to the magnitude of this pressure have been properly rejected (*2, 8*). Although we must agree that there is great uncertainty about the actual tissue pressure at the site of filtration, normally it is probably only a small fraction of the plasma colloid osmotic pressure. From digital examination it appears that the tissue pressure in starvation is subnormal, but even a profound decline could scarcely surpass 10 per cent of the intracapillary pressure. By exclusion, then, it appears that the balance between blood plasma and interstitial fluid does not represent a simple equilibrium, as is customarily postulated.

The assumption of actual equilibrium in such a dynamic situation as that at the capillary wall would seem to be unduly optimistic on *a priori* grounds. The fact of lymph flow is itself an indication of imperfect balance. It is well known that the prediction of rates of reactions or other events in nonequilibrium states from equilibrium equations is both hazardous and complicated. There is no reason to believe that the exchange between plasma and tissue fluid is an exception.

SUMMARY

Famine edema was produced experimentally in 34 normal men who lost a quarter of their body weight while subsisting for 6 months on a European type of semi-starvation diet. The ratio of extracellular water to cellular tissue was roughly doubled. Their clinical state closely resembled that seen in Europe in 1945. There were no signs of renal or cardiac failure. The plasma protein concentration fell only slightly and the A/G ratio remained within normal limits. The venous pressure was roughly 50 per cent below normal. Data from the field lend support to these indications that famine edema is not simply a result of hypoproteinemia or of renal or cardiac failure. It is concluded that there is a dynamic nonequilibrium state of the capillary wall and, accordingly, calculations from equilibrium equations are inadmissible.

References

1. BRULL, L., *et al.* *Les états de carence en Belgique pendant l'occupation allemand 1940–1944.* Paris: Herman et Cie, 1945.
2. BURCH, G. E., and SODEMANN, W. A. *J. clin. Invest.*, 1937, **16**, 845.
3. DAVIDSON, C. S., WILCKE, H. L., and REIMER, P., in press.
4. EDITORIAL. *J. Amer. med. Ass.*, 1945, **128**, 207.
5. GOUNELLE, H. *Bull. Soc. Med. Hop. Paris*, 1944, No. 25–26–27, 377.
6. GOUNELLE, H., MARCHE, J., and BACHET, M. *Bull. Mem. Soc. Med. Hop. Paris*, 10 July 1942, **146**.
7. LOEPER, VARAY A., and MENDE, R. *Bull. Acad. Med. Paris*, 1942, **126**, 335.
8. SMIRK, F. H. *Clin. Sci.*, 1935, **2**, 317.
9. STEVENSON, D. S. *Lancet*, 1944, **247**, 658.
10. YOUMANS, J. B. *Internat. Clin.*, 1936, **4**, 120–145.
11. YOUMANS, J. B., BELL, A., DONLEY, D., and FRANK, H. *Arch. int. Med.*, 1932, **50**, 843; 1933, **51**, 45.
12. YOUMANS, J. B., WELLS, H. S., DONLEY, D., and MILLER, D. G. *J. clin. Invest.*, 1934, **13**, 447.
13. ————. Personal communications and miscellaneous reports to the authors from officers in the U. S. and British Armies, 1945.

Antibacterial Action of Phenanthrene-related Substances

WALTER RAAB

Glenn Dale Sanatorium, Glenn Dale, Maryland

Intrapleural injection in tuberculous empyema (some mixed infected) of a vitamin A and D concentrate, considering it as a topical application of the cod-liver oil vitamins, resulted in disappearance of the pathogenic organisms (*4*).

In further clinical work, vitamin D alone proved to be responsible for the antibacterial action against tubercle bacilli, *Proteus vulgaris*, *Bacillus aerogenes*, nonhemolytic streptococcus, and *Staphylococcus aureus*.

In vitro vitamin D inhibited the growth of tubercle bacilli if added (50 units/cc.) to the culture media (Hohns, Loewenstein, Corpers Potato Media). By using the plating method, *Staph. aureus*, *P. vulgaris*, and *B. aerogenes* were inhibited. These clinical and laboratory findings are being reported elsewhere in detail (*4, 5*).

Vitamin D (activated ergosterol) is chemically ergosterol (*i.e.* characterized by the phenanthrene ring), the antirachitic property being due to intramolecular changes (*1*).

Since ergosterol (nonactivated) added to culture media inhibited tubercle bacilli and *Staph. aureus,* thus excluding the antirachitic factor as being responsible for the antibacterial action, we can assume that the chemical structure of vitamin D and ergosterol is responsible.

Cholesterol (a phenanthrene-related substance) added to culture media also inhibited tubercle bacilli and *Staph. aureus.*

Substances related to phenanthrene are very common in nature (e.g. sex hormones, heart glycosides, cholesterol, ergosterol, vitamin D, etc.) (*2*).

The substances reported here—cholesterol, ergosterol, and vitamin D—have in common the phenanthrene ring and the antibacterial action.

In vivo, in preliminary experiments, tuberculosis in guinea pigs was suppressed by injection of large doses of vitamin D (viosterol, 5,500,000 units D or more).

Bile salts are also phenanthrene related and have been known to have "bacteriostatic action on some species of microorganism" (*3*).

References

1. Bills, C. E. *The vitamins.* American Medical Association, 1939. P. 447.
2. Fieser, L. F. *The chemistry of natural products related to phenanthrene.* New York: Reinhold, 1936.
3. Goodman, L., and Gilman, A. *The pharmacological basis of therapeutics.* New York: Macmillan, 1941. P. 705.
4. Raab, W. *Dis. Chest,* 1946, 12, 68-71.
5. Raab, W. *Dis. Chest,* in press.

News and Notes

Valy Menkin, assistant professor of pathology at Duke University School of Medicine, has been appointed associate professor of experimental pathology in the newly created Department of Surgical Research at Temple University Medical School, Philadelphia.

Harold Hotelling was guest of honor at a testimonial dinner given 3 May by the Statistical Techniques Group, New York Chapter, American Statistical Association. Dr. Hotelling is leaving Columbia University at the end of the academic year to become professor of mathematical statistics at the University of North Carolina.

On behalf of the Group, Helen M. Walker presented gifts to Prof. and Mrs. Hotelling. The chairman, Irving Lorge, introduced the distinguished visitors who came to honor Dr. Hotelling. Among the speakers were: P. C. Mahalanobis, of Presidency College, Calcutta, India; Stuart Rice, chairman of the Statistical Commission of the Economic and Social Council of the United Nations; and Dean Pegram, of the Graduate Faculties of Columbia University.

Prof. Hotelling reviewed the changes in statistical theory and techniques that were developed during the 15 years of his professorship at Columbia University.

Fritz Lenz, former professor of eugenics at the University of Berlin and long-time editor of the *Archiv für Rassen- und Gesellschafts-Biologie,* is at Obernfelde bei Lubbecke, not far from Osnabrück in the British zone of occupation. All of his family survived the war.—*Paul Popenoe* (American Institute of Family Relations).

Roger Adams, head of the Chemistry Department, University of Illinois, was presented the Theodore William Richards Medal of the American Chemical Society's Northeastern Section at a meeting Thursday evening, 9 May, in Huntington Hall, Massachusetts Institute of Technology, Cambridge.

James Bryant Conant, president of Harvard University, reviewed the life and scientific achievements of Prof. Adams, who is a native of Boston and a Harvard graduate. Prof. Foster, head of the Chemistry Department in the State Teachers College, Framingham, Massachusetts, and Section chairman, presented the medal.

Norman W. Pirie, virus physiologist at the Rothamsted Experiment Station, England, is at the Worcester Foundation for Experimental Biology as a fellow of the Foundation.

Ottavio Munerati, well known for his genetical studies on sugar beets and other crops, writes that he has continued as director of the R. Stazione Experimentale di Bieticultura at Rovigo, Italy. Dr. Munerati is anxious to renew contacts with scientists in the United States. During the war he was able to publish only one paper: "Duration of the beet cycle" (*Monthly Bull. agric. Sci. Pract.*, 1942, **33**, 177T–214T).—*G. H. Coons* (Bureau of Plant Industry, Beltsville, Maryland).

Icie Macy Hoobler, of Detroit, director of the research laboratory of the Children's Fund of Michigan, will receive the Francis P. Garvan Medal honoring women in chemistry, it is announced by the American Chemical Society. The gold medal will be presented to Dr. Hoobler at the Society's 110th national meeting in Chicago in September.

The Garvan Medal is the latest of a long series of honors won by Dr. Hoobler, whose achievements have made her one of Detroit's outstanding scientists. She was the first woman ever to be chairman of an American Chemical Society Division, being elected to that office by the Division of Biological Chemistry in 1930, and the first woman to head a Local Section of the Society, serving as chairman of the Detroit Section in 1930. During the war Dr. Hoobler was a member of the National Research Council's Food and Nutrition Board.

Charles E. Teeter, Jr., professor of physics and chemistry at Cambridge Junior College and formerly staff member at M.I.T. Radiation Laboratory, has been appointed research associate at Boston University. He hopes to organize an acoustics research laboratory, covering the fields of supersonics and audio-acoustics.

N. P. Dubinin, professor at the Institute of Cytology of the Academy of Sciences of USSR, Oboukh Street No. 6, Moscow, USSR, has written as follows to the Department of Zoology, Columbia University:

> We are badly in need of scientific literature published in the United States. You would do a tremendous favor to the science of genetics in the USSR by asking all American colleagues working in genetics, including plant and animal breeding, to send us their publications issued during the war years.

All publications should be sent directly to Prof. Dubinin.

Capt. Curtis W. Sabrosky, U. S. Public Health Service, Office of Malaria Control in War Areas, formerly assistant professor of entomology at Michigan State College, has been appointed associate entomologist in the Division of Insect Identification of the U. S. Bureau of Entomology and Plant Quarantine, Washington, D. C.

Harry Eagle has been appointed adjunct professor of bacteriology in The Johns Hopkins School of Hygiene and Public Health. Dr. Eagle will retain his active status as senior surgeon in the U. S. Public Health Service, and his laboratory will be designated as the Laboratory of Experimental Therapeutics of the U. S. Public Health Service and The Johns Hopkins School of Hygiene and Public Health, supported jointly by the two agencies.

George W. White, professor of geology at the Ohio State University, has been appointed state geologist of Ohio. He succeeds Wilber Stout, who retired 1 May after having served the State Geological Survey for 35 years, the last 18 as state geologist.

S. R. M. Reynolds, Department of Embryology, Carnegie Institution of Washington, Baltimore, was elected a membre honoraire of the Société Française de Gynécologie at the meeting of this society on 21 January 1946.

William Bloom, professor of anatomy at the University of Chicago, has resigned from his position as chairman of the Department, effective 1 July 1946, at which time he will become a member of the recently established Institute of Radiobiology and Biophysics at the University. He will continue as professor in the Department of Anatomy. Peter P. H. De Bruyn, who has been promoted to an associate professorship, will assume the position of chairman of the Department.

Clyde Kohn, Department of Geography, Northwestern University, Evanston, is the new secretary of the National Council of Geography Teachers.

G. T. Nightingale has resigned from the Hawaiian Pineapple Company, where he has been conducting plant physiological research during the past seven and one-half years, and has accepted appointment as head of the Department of Plant Physiology at the Pineapple Research Institute of Hawaii, Honolulu 2.

Recent Deaths

Frances Louise Long, 60, formerly ecologist at the Carnegie Institution of Washington, died in Santa Barbara, California, on 17 March.

Simon Flexner, 83, director emeritus of the Rockefeller Institute for Medical Research and authority on meningitis, infantile paralysis, and dysentery, died on 2 May.

Rollin H. Stevens, 78, president of the recently-organized Detroit Institute of Cancer Research, died in Detroit on 17 May.

Joseph Sergi Kasanin, director of the psychiatry department of Mount Zion Hospital and former president of the American Orthopsychiatric Association, died on 4 May in San Francisco, California. Dr. Kasanin was author of *Language and thought in schizophrenia*.

Letters to the Editor

Carbon Dioxide as an Essential Factor in the Bacterial Decomposition of Cellulose

The decomposition of cellulose by a mixed culture of *Vibrio perimastrix* (A. Alarie. Ph.D. Thesis, McGill Univ., 1945), and another unidentified bacterium has been found to take place only in the presence of carbon dioxide.

Into each of four 125-ml. flasks was measured 50 ml. of a salt solution of pH 6.7 containing: 0.5 gram Na_2HPO_4; 0.5 gram KH_2PO_4; 0.2 gram $MgSO_4 \cdot 7H_2O$; 0.1 gram $CaCl_2 \cdot 2H_2O$; 0.1 gram NaCl; 0.02 gram $FeCl_3$; and 1.0 gram $NaNO_3$ per liter of distilled water. To each flask was added 0.5 gram of Whatman No. 41 filter paper in the form of small clippings, and finally the media were sterilized and inoculated. The flasks were fitted with an inlet tube at the bottom. Two were aerated with air from which the carbon dioxide had been removed by passing first through 50 per cent potassium hydroxide and then soda lime, and two received untreated air. The temperature was maintained at 80° F., and the duration of the fermentation was eight days.

The following results are typical of several experiments:

Flask No.	Treatment	Percentage decomposition of cellulose	pH*
1	Untreated air	5.2	7.0
2	" "	6.0	7.0
3	CO_2-free air	0	6.6
4	" " "	0	6.6

* Initially pH 6.7.

The only products found were traces of unidentified acids. Viable bacteria were present only in the flasks receiving untreated air. We believe this is the first demonstration that carbon dioxide is essential for the aerobic decomposition of cellulose by bacteria.

A. S. Perlin and M. Michaelis

Faculty of Agriculture (McGill University)
Macdonald College, Quebec

Use of the Shay Rat for Assay of Antiulcer Substance

Shay and his co-workers (*Gastroenterology*, 1945, 5, 43) have described a simple method for the production of gastric ulceration in the rat. These investigators suggested that their procedure might be adapted for use as a rapid assay method for any hormonal antiulcer agent. We have used their method for this purpose.

After many modifications of the procedure described by Shay, *et al.* had been tried, it was found that male rats about 60 days old and weighing 120–150 grams were most suitable. Having been raised on Purina Laboratory Chow, the rats are fasted in individual cages for 48 hours. The pylorus is then ligated under ether anesthesia and the fasting continued. Marked ulceration develops uniformly in the rumen in from seven to nine hours. This ulceration may be reduced in extent or prevented with a sufficient dose of an antiulcer substance isolated from human urine by a procedure to be described elsewhere. The antiulcer material was administered intravenously at the time of the operation, although intraperitoneal injection or administration by mouth sometime prior to the pylorus ligation may prove effective.

This rat preparation may also be useful for the evaluation of antisecretory as well as antiulcer agents, for Shay, *et al.* give evidence that the occurrence of gastric ulceration in their rats may be dependent on acid and pepsin secretion. For this assay of antiulcer substances it is obvious that the Shay Rat offers many advantages over dog preparations.

Frances Pauls, Arne N. Wick,
and Eaton M. MacKay

Scripps Metabolic Clinic, La Jolla, California

Reprints to Denmark

Scientists in Denmark have expressed to me their regret that they do not yet receive American scientific journals regularly and that only a few of their colleagues in the United States are sending them reprints. Apparently many American scientists are not yet aware of the fact that printed matter can be sent to Scandinavian countries by ordinary mail. It would be greatly appreciated by Scandinavian scientists if their American colleagues would send them reprints of work within their special field from 1940 up to date without waiting for requests. Requests for reprints may be very much delayed, or in many cases impossible to make, because of the lack of journals since the beginning of the war.

The writer would be very much obliged if the same favor might be extended to him when, after 1 June, he takes over the Biochemistry Department of the Polytechnic Institute (Danmarks Tekniske Højskole) in Copenhagen.

Henrik Dam

The Rockefeller Institute for Medical Research
New York City

Differentiation of Antibiotics by Resistant Strains

W. J. Robbins, at a meeting of the New York City branch of the Society of American Bacteriologists on 27 December 1945, showed that a strain of *Staphylococcus aureus* made resistant to penicillin was affected by antibiotics produced by Basidiomycetes, demonstrating that this method could be used for the differentiation of unknown antibiotics.

We had obtained from an unclassified Actinomyces an antibiotic which by bacterial spectrum showed a marked similarity to highly purified streptomycin, differing only quantitatively. Robbins' method was employed by us in an attempt to further characterize the antibiotic. For this purpose we had previously developed in our laboratory two strains of *Staph. aureus* (A.T.C.C. 6538 and F.D.A. 209) highly resistant to streptomycin. Both resistant strains were found to be as sensitive to the unknown antibiotic as the original strains. We could thus demonstrate by this method that this unknown antibiotic was different from streptomycin in spite of their spectral similarities.

In order to ascertain the relative degree of specificity of the resistance thus obtained, we developed strains from two parent cultures which were made highly resistant to crystalline penicillin G and examined their resistance towards penicillins F and X. It was found that the "normal" *Staph. aureus* 6538 was sensitive to penicillins F, G, and X in concentrations of 0.063, 0.078, and 0.039 μg./ml., respectively, while the "resistant" strain required 0.625, 0.625, and 1.25 μg./ml. Similar results were obtained with *Staph. aureus* 209.

These results indicate that a strain with acquired resistance against one penicillin is also resistant in the same order of magnitude to the two other penicillins. Such phenomena of group resistance of the same degree have been known for a long time with substances other than antibiotics, as in the case of resistance to various sulfonamides. We have also shown group resistance against various inorganic and organic mercury compounds with a strain of *Pseudomonas aeruginosa* made resistant to merthiolate. Thus, it becomes evident that the acquired resistance of bacteria is not as specific as are immune bodies produced by chemical substances, demonstrated by Landsteiner and co-workers.

It is likely that antibiotics and other antibacterial substances of diverse chemical structure can be differentiated by this method, as shown by Robbins and ourselves. However, the fact that three different penicillins cannot be differentiated by a penicillin G resistant strain of *Staph. aureus* indicates the limitations of this technique.

Our results will be published in detail at an early date. Upon the completion of our study, P. G. Stansly, in a letter to the editor (*Science*, 1946, 103, 402) suggested the possible use of this method which has been employed by us.

P. C. EISMAN, W. S. MARSH, and R. L. MAYER
Research Laboratories, Ciba Pharmaceutical Products, Inc., Summit, New Jersey

Nuclear Fission Bomb as Initiator of Earthquakes

In the California earthquake of 1906 the potential energy stored was 1.7×10^{24} ergs (N. H. Heck. *Earthquakes*. Princeton, 1936); the energy liberated in the Charleston earthquake of 1886 was estimated as 1.4×10^{23} ergs. At Freehold, New Jersey in 1938, the earthquake liberated 10^{15} ergs of the energy stored in the pre-earthquake strain in the crust of the earth at that locality. This gives us the order of magnitude of potential energies expended in seismic disturbances, but it gives only a little about the magnitude of energy necessary to initiate an earthquake.

It would be safe, however, to assume that the "trigger" energy need not be more than the potential energy of the earthquake itself in order to release the seismic strain already existing. A release of "trigger" energy of more than 10^{23} ergs is likely to result in a small earthquake if the "trigger" acts at the time of relaxation in the earth's crust and/or far away from the strained locality. Such a relaxation usually takes place shortly after a period of an excessive seismic activity. Energy amounting to 10^{23} ergs liberated at the time and at the place of maximum strain may result in a major earthquake dangerous not only to those who pull the "trigger," but also to those who have little or nothing to do with the experiment.

Early after Pearl Harbor, a plan to induce an earthquake in Japanese waters and to ruin by means of the earthquake so produced the key industrial centers of Japan was seriously considered by military and scientific authorities here. This plan was found feasible if between 3,000 and 6,000 tons of TNT were exploded near the Pacific shores of Japan. The plan was not carried out because the nuclear fission bomb was under way, and probably it was expected to prepare the bomb and release it over Japan much earlier than this actually happened.

In the artificial induction of an earthquake it is not only the quantity of energy released but the speed of its release that is of primary importance. If a line of a strain stretching for hundreds of kilometers exists in the crust of the earth, a much smaller quantity of energy than 10^{23} ergs, liberated very quickly on a spot of the line, will break the equilibrium, and the crust fissure starting at the point of explosion will proceed along the line of the strain with the velocity of sound in the rock crust.

In the rupturing or faulting process of the California earthquake, the energy of 1.7×10^{24} ergs was released during several hours, perhaps days. Not more than 60 per cent of this energy was liberated within approximately nine minutes. This gives

$$\frac{1.7 \times 10^{24} \times 0.60}{9 \times 60} = 1.9 \times 10^{21} \text{ ergs/sec.}$$

as the power of the earthquake.

During the explosive decomposition of one kilogram of TNT, the quantity of energy released is 820.7 big calories, or 3.5×10^5 kilogram meters. The speed of release of TNT energy is about 0.000009 second. Therefore, the power of explosion of 5,000 metric tons of TNT is

$$\frac{3.5 \times 10^5 \times 5{,}000 \times 1{,}000 \times 9.8 \times 10^7}{9 \times 10^{-6}} = 1.9 \times 10^{25} \text{ ergs/sec.}$$

The last figure shows that the power of explosion of 5,000 tons of TNT should be sufficient to initiate an earthquake. The nuclear fission bomb released over Hiroshima was (according to published reports) equivalent to 20,000 tons of TNT. It is not clear whether the equivalent refers to the amount of energy liberated or to the power of the explosion. Even assuming that the latter variant is the correct one, the power of the nuclear fission bomb was of the order of 10^{26} ergs/sec.—amply sufficient to initiate an earthquake, if exploded on or under the surface of land or sea.

It was estimated by the author (*Earthquakes on the expanding earth*. Transactions of 1944, American Geophysical Union) that the strength of the solid shell of the earth to the depth of 60 kilometers in a section along a great circle of our planet is such that 1.6×10^{26} ergs is necessary to crack the earth's shell into two halves three meters apart. Nuclear fission energies are approaching this critical output, and further experimenting with large nuclear fission bombs must be carried out with great precautions.

In particular this refers to the scheduled experiments to be carried out by the Navy in the mid-Pacific on a certain date in June. The author is afraid that there may be no survivors to report on the experiment if the bomb of Hiroshima-size is exploded on or under the ocean surface, and if the preceding months are below their normal seismic activity.

If a rupture in the ocean bed caused by the test is sufficiently deep and therefore hot, the flow of water into the crack and the steam formed therein will deepen and broaden the rupture. The bulge of steam may produce a siesmic tidal wave which may sweep away all ships—the targets and nontargets.

Furthermore, if the nuclear fission bomb in the planned experiment is larger than that released over Hiroshima, the "mushroom" of steam and dust from the bottom of the sea may surpass that of Krakatoa in the year 1883 by many times, both in volume of the erupted matter and in the height to which it is erupted.

The solar constant was slightly affected for several decades by the dust thrown out in the Krakatoa (C. G. Abbot and F. E. Fowle. *Volcanoes and climate.* Smithsonian Misc. Collection, 1913, Vol. 60, No. 29, 15). The climate of the earth may be affected unfavorably for many decades if the quantity of dust erupted as a result of the experiment is several times that resulting from the explosion of Krakatoa.

This consideration requires an extreme cautiousness in scheduling the experiment. The strain in the earth's crust must be estimated *first*, and the experiment performed at the time of a minimum strain.

If all precautions are taken, this test may be of considerable value to seismology and tectonophysics. With the exact time of explosion, its energy, and location of epicenter known, the time and the path of travel of different types of seismic waves can be studied with great precision. The experiment may be especially valuable for better study of surface and shallow waves, and waves going through the core of the earth. Records of seismographs in such an accurate seismological experiment may give a better understanding of the structure of the earth's crust and its depth, thus contributing to the science of tectonophysics.

The author is especially interested in observations on the direct transverse wave (S′) through the core and in the continued records for 14 days after the explosion. The absence of a focus of S′ wave at the antipode of the explosion spot would favor the writer's hypothesis of a heavy gaseous core of the earth, and occurrences of excessive earthquakes during the half-lunar period after the explosion would give valuable data for evaluation of the lagging coefficient of earthquakes after the maximum strain has been reached.

ANATOL JAMES SHNEIDEROV

The Johns Hopkins University

"Posterity may regard this book as one of the major scientific achievements of the first half of the twentieth century."

—AMERICAN MATHEMATICAL SOCIETY BULLETIN

Theory of Games and Economic Behavior

By JOHN VON NEUMANN and OSKAR MORGENSTERN

A mathematician and an economist have combined their knowledge in this new approach to a mathematical theory of economic and social organization, based on a theory of games and strategy. Their book gives a detailed account of this theory of games, developed by Mr. Von Neumann over a period of 15 years, and contains numerous applications to characteristic games of strategy, and to economic and social theory.

No technical knowledge of any definite part of mathematics is required of the reader, but he should be familiar with the mathematical way of reasoning, procedure, and notation.

644 pages, illustrated, $10.00

At your bookstore

PRINCETON

UNIVERSITY PRESS

Book Reviews

New drugs. Arthur D. Herrick. New York: Revere Publishing Co., 1946. Pp. xiv + 303. $4.00.

New drugs is a practicing attorney's contribution to the manufacturer's problem of how to properly launch a new drug into interstate commerce. Its title is perhaps ambiguous, leading one at first to believe that the contents deal with descriptions of new therapeutic agents.

Meeting the requirements of the Food, Drug, and Cosmetic Act is beyond the capacity of those who are not thoroughly conversant with, or who fail to comprehend in detail, its many provisions and regulations. Mr. Herrick, an expert in the field, recognized this and planned his book as a guide through the maze of legal pitfalls in the path of anyone who is introducing a new product or altering the formula or label of a drug already on the market.

The book is easy to read because of its nonlegalistic language. It covers the application of the Act to every phase of new drug qualification. The author's technic is simple. He calls attention to the problem and then details the procedure required for its solution. Since the original manuscript was read and constructively criticized by officials of the Food and Drug Administration, the stamp of authority has been doubly placed upon it.

The text begins with a discussion of the nature of the Food, Drug, and Cosmetic Act and how it is presently administered. The author points out that one of the difficulties in meeting the provisions set forth, in the first years after enactment, was a variable policy of administration. He then progresses to an examination of several facets of the definition for the term ''new drug.'' The place of ''new'' devices, cosmetics, and foods under this section of the Act is clarified.

The book progresses to a discussion of the procedure envisaged by Section 505 in assuring the safety of new drugs before they can be marketed. How to apply for permission to market is carefully outlined. The detailed information asked for in the application is extensive and covers such points as methods of manufacture and control, components and composition, labeling and samples.

One of the important sections of the text treats the investigations necessary to determine safety. The author states that ''naturally the principal data supporting the new drug application deals with the investigations that have been made to determine the safety of the drug for use under the conditions prescribed for it.'' These include laboratory observations, animal research, clinical studies, and literature surveys. The latter are of value in supporting the clinical findings of the studies specifically undertaken by the manufacturer.

Equally helpful treatment is given the problems resulting from refusal by the Food and Drug Administration to grant permission for introduction of the product into interstate commerce.

A helpful appendix brings the Act up to date and includes new state and city drug legislation. The book closes with a statement of the official rules of the American Medical Association Council on Pharmacy and Chemistry.

This is a text that fills a definite need in the field of drug manufacturing and distribution.

L. Wait Rising

University of Washington, Seattle

Soap in industry. Georgia Leffingwell and Milton Lesser. Brooklyn, N. Y.: Chemical Publishing Co., 1946. Pp. viii + 204. $4.00.

The scope of this volume is much better described by the first sentence of its Introduction than by its title. Here the authors state: ''This book is intended as an *indicative* rather than exhaustive survey of the industrial uses of soluble (?) soaps. . . .'' To be sure, this is in reality not a book, for there is no continuity of thought or a visible plan connecting the individual chapters; rather, one gains the impression of having been presented with a conveniently bound collection of trade-journal clippings. The 23 chapters, covering 181 pages, range over the following topics (in order): Animal Husbandry, Building and Construction, Cosmetics, Dentistry, Inks and Ink Making, Insecticides, Leather, Lubricants, Milk Production, Mining and Ore Treating, Oil Production, Paints, Paper and Packaging, Plastics, Polishes and Cleaners (for wood, metal, and glass), Restaurant Sanitation, Road Building and Maintenance, Rubber Production, Textiles, Dyeing and Printing Textiles, Wool Production, Miscellaneous.

The thoroughness with which each topic has been covered may be measured to an extent by the number of literature and patent references appended. This score varies from zero for two articles to 33 for Rubber Production. It is also curious to observe that the majority of references are not much older than five years, while nearly all the ''formulae'' cited were probably already well known at the beginning of this century and are mostly quoted from the standard formularies.

The use of technical nomenclature is somewhat sloppy, as is apparent from the ''soluble'' soaps in the first sentence of the book. These really are the water-dispersible (perhaps soluble) sodium and potassium soaps of ordinary fatty acids in contrast with the more oil-soluble, multivalent metal soaps.

In view of the obvious shortcomings, such as the incompleteness of literature and patent references, not to speak of the style, this booklet will hardly be attractive to the technical and scientific worker. However, because of its many useful hints and good ''sales talks'' the volume will find a place in the hands of the sales personnel of the soap and detergent industry. The remarkably thorough subject index of more than 1,400 entries adds to the usefulness of this compilation.

A. Bondi

International Lubricant Corporation, New Orleans

SCIENCE

Vol. 103, No. 2684 Friday, June 7, 1946

On the Theory of Scales of Measurement

S. S. Stevens

Director, Psycho-Acoustic Laboratory, Harvard University

FOR SEVEN YEARS A COMMITTEE of the British Association for the Advancement of Science debated the problem of measurement. Appointed in 1932 to represent Section A (Mathematical and Physical Sciences) and Section J (Psychology), the committee was instructed to consider and report upon the possibility of "quantitative estimates of sensory events"—meaning simply: Is it possible to measure human sensation? Deliberation led only to disagreement, mainly about what is meant by the term measurement. An interim report in 1938 found one member complaining that his colleagues "came out by that same door as they went in," and in order to have another try at agreement, the committee begged to be continued for another year.

For its final report (1940) the committee chose a common bone for its contentions, directing its arguments at a concrete example of a sensory scale. This was the Sone scale of loudness (S. S. Stevens and H. Davis. *Hearing*. New York: Wiley, 1938), which purports to measure the subjective magnitude of an auditory sensation against a scale having the formal properties of other basic scales, such as those used to measure length and weight. Again the 19 members of the committee came out by the routes they entered, and their views ranged widely between two extremes. One member submitted "that any law purporting to express a quantitative relation between sensation intensity and stimulus intensity is not merely false but is in fact meaningless unless and until a meaning can be given to the concept of addition as applied to sensation" (Final Report, p. 245).

It is plain from this and from other statements by the committee that the real issue is the meaning of measurement. This, to be sure, is a semantic issue, but one susceptible of orderly discussion. Perhaps agreement can better be achieved if we recognize that measurement exists in a variety of forms and that scales of measurement fall into certain definite classes. These classes are determined both by the empirical operations invoked in the process of "measuring" and by the formal (mathematical) properties of the scales. Furthermore—and this is of great concern to several of the sciences—the statistical manipulations that can legitimately be applied to empirical data depend upon the type of scale against which the data are ordered.

A CLASSIFICATION OF SCALES OF MEASUREMENT

Paraphrasing N. R. Campbell (Final Report, p. 340), we may say that measurement, in the broadest sense, is defined as the assignment of numerals to objects or events according to rules. The fact that numerals can be assigned under different rules leads to different kinds of scales and different kinds of measurement. The problem then becomes that of making explicit (a) the various rules for the assignment of numerals, (b) the mathematical properties (or group structure) of the resulting scales, and (c) the statistical operations applicable to measurements made with each type of scale.

Scales are possible in the first place only because there is a certain isomorphism between what we can do with the aspects of objects and the properties of the numeral series. In dealing with the aspects of objects we invoke empirical operations for determining equality (classifying), for rank-ordering, and for determining when differences and when ratios between the aspects of objects are equal. The conventional series of numerals yields to analogous operations: We can identify the members of a numeral series and classify them. We know their order as given by convention. We can determine equal differences, as $8-6=4-2$, and equal ratios, as $8/4=6/3$. The isomorphism between these properties of the numeral series and certain empirical operations which we perform with objects permits the use of the series as a *model* to represent aspects of the empirical world.

The type of scale achieved depends upon the character of the basic empirical operations performed. These operations are limited ordinarily by the nature of the thing being scaled and by our choice of procedures, but, once selected, the operations determine that there will eventuate one or another of the scales listed in Table 1.[1]

The decision to discard the scale names commonly encountered in writings on measurement is based on the ambiguity of such terms as "intensive" and "extensive." Both ordinal and interval scales have at times been called intensive, and both interval and ratio scales have sometimes been labeled extensive.

TABLE 1

Scale	Basic Empirical Operations	Mathematical Group Structure	Permissible Statistics (invariantive)
NOMINAL	Determination of equality	*Permutation group* $x' = f(x)$ $f(x)$ *means any one-to-one substitution*	Number of cases Mode Contingency correlation
ORDINAL	Determination of greater or less	*Isotonic group* $x' = f(x)$ $f(x)$ means any monotonic increasing function	Median Percentiles
INTERVAL	Determination of equality of intervals or differences	*General linear group* $x' = ax + b$	Mean Standard deviation Rank-order correlation Product-moment correlation
RATIO	Determination of equality of ratios	*Similarity group* $x' = ax$	*Coefficient of variation*

It will be noted that the column listing the basic operations needed to create each type of scale is cumulative: to an operation listed opposite a particular scale must be added all those operations preceding it. Thus, an interval scale can be erected only provided we have an operation for determining equality of intervals, for determining greater or less, and for determining equality (not greater and not less). To these operations must be added a method for ascertaining equality of ratios if a ratio scale is to be achieved.

In the column which records the group structure of each scale are listed the mathematical transformations which leave the scale-form invariant. Thus, any numeral, x, on a scale can be replaced by another numeral, x', where x' is the function of x listed in this column. Each mathematical group in the column is contained in the group immediately above it.

The last column presents examples of the type of statistical operations appropriate to each scale. This column is cumulative in that *all* statistics listed are admissible for data scaled against a ratio scale. The criterion for the appropriateness of a statistic is *invariance* under the transformations in Column 3. Thus, the case that stands at the median (mid-point) of a distribution maintains its position under all transformations which preserve order (isotonic group), but an item located at the mean remains at the mean only under transformations as restricted as those of the linear group. The ratio expressed by the coefficient of variation remains invariant only under the similarity transformation (multiplication by a constant). (The rank-order correlation coefficient is usually deemed appropriate to an ordinal scale, but actually this statistic assumes equal intervals between successive ranks and therefore calls for an interval scale.)

Let us now consider each scale in turn.

NOMINAL SCALE

The *nominal scale* represents the most unrestricted assignment of numerals. The numerals are used only as labels or type numbers, and words or letters would serve as well. Two types of nominal assignments are sometimes distinguished, as illustrated (a) by the 'numbering' of football players for the identification of the individuals, and (b) by the 'numbering' of types or classes, where each member of a class is assigned the same numeral. Actually, the first is a special case of the second, for when we label our football players we are dealing with unit classes of one member each. Since the purpose is just as well served when any two designating numerals are interchanged, this scale form remains invariant under the general substitution or permutation group (sometimes called the symmetric group of transformations). The only statistic relevant to nominal scales of Type A is the number of cases, e.g. the number of players assigned numerals. But once classes containing several individuals have been formed (Type B), we can determine the most numerous class (the mode), and under certain conditions we can test, by the contingency methods, hypotheses regarding the distribution of cases among the classes.

---

[1] A classification essentially equivalent to that contained in this table was presented before the International Congress for the Unity of Science, September 1941. The writer is indebted to the late Prof. G. D. Birkhoff for a stimulating discussion which led to the completion of the table in essentially its present form.

The nominal scale is a primitive form, and quite naturally there are many who will urge that it is absurd to attribute to this process of assigning numerals the dignity implied by the term measurement. Certainly there can be no quarrel with this objection, for the naming of things is an arbitrary business. However we christen it, the use of numerals as names for classes is an example of the "assignment of numerals according to rule." The rule is: Do not assign the same numeral to different classes or different numerals to the same class. Beyond that, anything goes with the nominal scale.

ORDINAL SCALE

The *ordinal scale* arises from the operation of rank-ordering. Since any 'order-preserving' transformation will leave the scale form invariant, this scale has the structure of what may be called the isotonic or order-preserving group. A classic example of an ordinal scale is the scale of hardness of minerals. Other instances are found among scales of intelligence, personality traits, grade or quality of leather, etc.

As a matter of fact, most of the scales used widely and effectively by psychologists are ordinal scales. In the strictest propriety the ordinary statistics involving means and standard deviations ought not to be used with these scales, for these statistics imply a knowledge of something more than the relative rank-order of data. On the other hand, for this 'illegal' statisticizing there can be invoked a kind of pragmatic sanction: In numerous instances it leads to fruitful results. While the outlawing of this procedure would probably serve no good purpose, it is proper to point out that means and standard deviations computed on an ordinal scale are in error to the extent that the successive intervals on the scale are unequal in size. When only the rank-order of data is known, we should proceed cautiously with our statistics, and especially with the conclusions we draw from them.

Even in applying those statistics that are normally appropriate for ordinal scales, we sometimes find rigor compromised. Thus, although it is indicated in Table 1 that percentile measures may be applied to rank-ordered data, it should be pointed out that the customary procedure of assigning a value to a percentile by interpolating linearly within a class interval is, in all strictness, wholly out of bounds. Likewise, it is not strictly proper to determine the mid-point of a class interval by linear interpolation, because the linearity of an ordinal scale is precisely the property which is open to question.

INTERVAL SCALE

With the *interval scale* we come to a form that is "quantitative" in the ordinary sense of the word. Almost all the usual statistical measures are applicable here, unless they are the kinds that imply a knowledge of a 'true' zero point. The zero point on an interval scale is a matter of convention or convenience, as is shown by the fact that the scale form remains invariant when a constant is added.

This point is illustrated by our two scales of temperature, Centigrade and Fahrenheit. Equal intervals of temperature are scaled off by noting equal volumes of expansion; an arbitrary zero is agreed upon for each scale; and a numerical value on one of the scales is transformed into a value on the other by means of an equation of the form $x' = ax + b$. Our scales of time offer a similar example. Dates on one calendar are transformed to those on another by way of this same equation. On these scales, of course, it is meaningless to say that one value is twice or some other proportion greater than another.

Periods of time, however, can be measured on ratio scales and one period may be correctly defined as double another. The same is probably true of temperature measured on the so-called Absolute Scale.

Most psychological measurement aspires to create interval scales, and it sometimes succeeds. The problem usually is to devise operations for equalizing the units of the scales—a problem not always easy of solution but one for which there are several possible modes of attack. Only occasionally is there concern for the location of a 'true' zero point, because the human attributes measured by psychologists usually exist in a positive degree that is large compared with the range of its variation. In this respect these attributes are analogous to temperature as it is encountered in everyday life. Intelligence, for example, is usefully assessed on ordinal scales which try to approximate interval scales, and it is not necessary to define what zero intelligence would mean.

RATIO SCALE

Ratio scales are those most commonly encountered in physics and are possible only when there exist operations for determining all four relations: equality, rank-order, equality of intervals, and equality of ratios. Once such a scale is erected, its numerical values can be transformed (as from inches to feet) only by multiplying each value by a constant. An absolute zero is always implied, even though the zero value on some scales (e.g. Absolute Temperature) may never be produced. All types of statistical measures are applicable to ratio scales, and only with these scales may we properly indulge in logarithmic transformations such as are involved in the use of decibels.

Foremost among the ratio scales is the scale of number itself—cardinal number—the scale we use when we count such things as eggs, pennies, and apples. This scale of the numerosity of aggregates is so basic and so common that it is ordinarily not even mentioned in discussions of measurement.

It is conventional in physics to distinguish between two types of ratio scales: *fundamental* and *derived.* Fundamental scales are represented by length, weight, and electrical resistance, whereas derived scales are represented by density, force, and elasticity.

These latter are *derived* magnitudes in the sense that they are mathematical functions of certain fundamental magnitudes. They are actually more numerous in physics than are the fundamental magnitudes, which are commonly held to be basic because they satisfy the criterion of *additivity.* Weights, lengths, and resistances can be added in the physical sense, but this important empirical fact is generally accorded more prominence in the theory of measurement than it deserves. The so-called fundamental scales are important instances of ratio scales, but they are only instances. As a matter of fact, it can be demonstrated that the fundamental scales could be set up even if the physical operation of addition were ruled out as impossible of performance. Given three balances, for example, each having the proper construction, a set of standard weights could be manufactured without it ever being necessary to place two weights in the same scale pan at the same time. The procedure is too long to describe in these pages, but its feasibility is mentioned here simply to suggest that physical addition, even though it is sometimes possible, is not necessarily the basis of all measurement. Too much measuring goes on where resort can never be had to the process of laying things end-to-end or of piling them up in a heap.

Ratio scales of psychological magnitudes are rare but not entirely unknown. The Sone scale discussed by the British committee is an example founded on a deliberate attempt to have human observers judge the loudness ratios of pairs of tones. The judgment of equal intervals had long been established as a legitimate method, and with the work on sensory ratios, started independently in several laboratories, the final step was taken to assign numerals to sensations of loudness in such a way that relations among the sensations are reflected by the ordinary arithmetical relations in the numeral series. As in all measurement, there are limits imposed by error and variability, but within these limits the Sone scale ought properly to be classed as a ratio scale.

To the British committee, then, we may venture to suggest by way of conclusion that the most liberal and useful definition of measurement is, as one of its members advised, "the assignment of numerals to things so as to represent facts and conventions about them." The problem as to what is and is not measurement then reduces to the simple question: What are the rules, if any, under which numerals are assigned? If we can point to a consistent set of rules, we are obviously concerned with measurement of some sort, and we can then proceed to the more interesting question as to the kind of measurement it is. In most cases a formulation of the rules of assignment discloses directly the kind of measurement and hence the kind of scale involved. If there remains any ambiguity, we may seek the final and definitive answer in the mathematical group-structure of the scale form: In what ways can we transform its values and still have it serve all the functions previously fulfilled? We know that the values of all scales can be multiplied by a constant, which changes the size of the unit. If, in addition, a constant can be added (or a new zero point chosen), it is proof positive that we are not concerned with a ratio scale. Then, if the purpose of the scale is still served when its values are squared or cubed, it is not even an interval scale. And finally, if any two values may be interchanged at will, the ordinal scale is ruled out and the nominal scale is the sole remaining possibility.

This proposed solution to the semantic problem is not meant to imply that all scales belonging to the same mathematical group are equally precise or accurate or useful or "fundamental." Measurement is never better than the empirical operations by which it is carried out, and operations range from bad to good. Any particular scale, sensory or physical, may be objected to on the grounds of bias, low precision, restricted generality, and other factors, but the objector should remember that these are relative and practical matters and that no scale used by mortals is perfectly free of their taint.

Technical Papers

Apparent Visible Violet Radiation in the Recent Large Sunspot Group

JAMES C. BARTLETT, JR.
American International Academy, Inc.
Baltimore, Maryland

The appearance of well-defined colors in sunspots, while not unknown, is rare enough to be noteworthy. As far back as 1826 Capocci reported violet tints associated with umbrae; Secchi, at Rome, using a Merz polarizer, saw a rosy tinge to umbrae; while the celebrated Herr Schwabe of Dessau saw occasional umbrae which were reddish-brown. Miss Brown, of Harvard, noted occasionally red-tinted umbrae. Young saw *all* umbrae as deep purple rather than black (*1*), but was disposed to regard this color as false and caused by the secondary spectrum of achromatics. However, it is clear that the *occasional* nature of the phenomenon rather disposes of the argument in favor of color by contrast, overcorrected objectives, etc. Moreover, such colors often have been seen in spots immediately adjacent to others which showed no color at all.

The normal color scheme of a sunspot is black and gray, the umbra being black and the penumbra, gray to yellowish-gray. Although Young fancied all umbrae to be very dark purple, to most eyes they appear as simply black by contrast with the photosphere. Penumbrae normally vary from very light to dark gray, although the apparent colors of both umbrae and penumbrae will be modified by the color of the helioscope screen.

A recent example of color was afforded by the Great Group of spots which appeared in the sun's northern hemisphere from 29 January to 12 February, and which has now returned to view. These spots, visible to the naked eye, and among the largest ever recorded, caused considerable radio disturbance and induced a brilliant aurora which was plainly seen at the latitude of Baltimore.

The writer first saw these spots on 29 January, when they were just coming around the following limb. By 1 February they were far enough on the disc to be seen well. At that time it was discovered that the so-called Great Group really consisted of three distinct groups: two relatively small groups, followed by an enormous penumbral field which enveloped a number of umbrae. The two principal umbrae of this group were unmistakably of a very dark violet hue, although no other umbrae within the same penumbral field, nor the umbrae of the two groups preceding, showed any color whatever. The penumbra of the largest group was normally gray. The penumbral filaments were distorted and confused, and a brilliant flocculus-like mass was observed, superimposed above the penumbra in its approximate center.

On 2 February the entire penumbra of this group had taken on a red-violet tint, the principal umbrae remaining very dark violet. On the same date the penumbra was found to be much rifted and ragged, and shot through in spots by brilliant eruptions manifested as bright spots within the penumbra.

On 3 February the penumbra had become greatly enlarged in area and had also changed color, now appearing as brown-violet. The two principal umbrae remained dark violet, all other umbrae within the penumbral field appearing normally black. Brilliant spots, rifts, and lanes in the penumbra were frequent, and a brilliant, detached flocculus was seen suspended above the largest umbra. A similar flocculus was observed over the leading umbra of the group immediately preceding the penumbral field group, but no color whatever was seen in the former.

On the following day *all* of the umbrae within the penumbral field group had assumed dark-violet tones, the umbrae in the two smaller groups preceding remaining normally black. The penumbra of the largest group remained brown-violet and continued to exhibit confused filamentation and brilliant eruptions. A detached flocculus was observed over another umbra within the field. It was clear that very violent activity was in progress here, apparently in concert with emission of radiation in the violet end of the spectrum, with invisible but implied emission in the ultraviolet. On the night of 7 February, this group having just passed the meridian, a brilliant aurora was seen in Baltimore even above the city lights.

On 8 February, when this group was nearing the preceding limb, the color of the penumbra had faded out to a pale violet, the principal umbrae appearing dark violet. Again, no color was seen in the adjacent groups. On 4 March when this group was again in position for good observation, the penumbra was seen to be *varicolored*—a sort of orange-brown on the west, fading into neutral gray on the east. The three principal umbrae then visible were deep violet and appeared to be surrounded by a red haze. No color was seen in any other spots on the disc.

The writer would like to emphasize that at no time was color *anticipated*. Moreover, the only previous occasion on which well-marked color had been seen was in 1928, when the writer was using the 8-inch Clark refractor of the Maryland Academy of Sciences.

The helioscope used in the observations of present date was one which has the effect of reddening the photosphere but is otherwise neutral. It consists of a thin glass slide, smoked to the proper density and mounted in an adapter which screws directly onto the eyepiece. The writer has found this type of screen very satisfactory, since it intercepts the heat perfectly and gives a beautifully defined, natural-colored image of the sun in which the photosphere appears as light orange. Umbrae normally appear black and penumbrae gray against the orange background. The telescope used is a 3-inch one giving splendid definition with very fine color correction. The objective was ground for the writer some years ago by the American Optical Company and stands up perfectly with respect to color on even such bright objects as Jupiter when seen against a dark sky. It is felt, therefore, that the observations cited above were observations of fact and not mere illusions.

Reference

1. Young, C. A. *The sun.* New York: Appleton, 1881. Footnote, p. 117.

The Activity of Synthetic Folic Acid in Purified Rations for the Chick[1]

T. D. Luckey, P. R. Moore, C. A. Elvehjem, and E. B. Hart

Department of Biochemistry
College of Agriculture, University of Wisconsin

Previous studies have shown that vitamin B_{10} and B_{11} preparations (*3*), impure folic acid (from University of Texas) (*4*), crystalline isolated third *L. casei* factor (*4, 6*), and pure isolated vitamin B_c (*5*) have activity for growth, feathering, and hemoglobin formation in growing chicks. These earlier studies were necessarily limited by the lack of pure material or sufficient quantities of the compound. Since synthetic folic acid,[2] which has been reported active for growth and hematopoiesis (*1*), has now become available, it is important to study the activity of this compound under our experimental conditions.

Experimental method. Day-old White Leghorn cockerels from a commercial hatchery were maintained in electrically heated cages (32–37°) with raised screen bottoms for three or four days on a basal ration with the following percentage composition: dextrin, 61; casein, 18; gelatin, 10; l-cystine, 0.3; salts V (*2*), 6; soybean oil, 5; α-tocopherol, 0.3 mg.; 2-methyl-1,4-naphthaquinone, 0.05 mg.; thiamin · HCl, 0.3 mg.; riboflavin, 0.6 mg.; Ca pantothenate, 2 mg.; choline, Cl, 150 mg.; nicotinic acid, 5 mg.; pyridoxine · HCl, 0.4 mg.; biotin, 0.02 mg.; and i-inositol, 100 mg. In addition 1,700 U.S.P. units of vitamin A and 170 A.O.A.C. units of vitamin D_3 were administered by dropper. Chicks within a 10-gram weight range were then divided uniformly into groups of six, and supplements were added to the diet as follows: synthetic folic acid at levels of 10–300γ/100 grams of ration, isolated vitamin B_c, and preparations of vitamins B_{10} and B_{11} containing different amounts of "folic acid"[3] which were fed for comparison.

The three experiments were terminated when the chicks were four weeks old. The methods used for determining hemoglobin and measuring feather development were the same as those used previously (*3*). The hematocrit determinations were made following the procedure of O'Dell, *et al.* (*9*).

Results. The addition of 25γ of synthetic folic acid to our basal ration prevents the reduced growth, poor feathering condition, and low hemoglobin and hematocrit values which are consistently obtained when this ration is fed to chicks. Twenty-five micrograms of isolated crystalline vitamin B_c gave a similar effect, although the growth was slightly less than in chicks fed similar levels of synthetic folic acid. When vitamin C or whole liver powder was fed with folic acid, the chicks grew somewhat better than when fed folic acid alone (compare Groups 10 and 11 with 4). The addition to the diet of 50γ of of α-pyracin (2-methyl-3-hydroxy-4-hydroxymethyl-5-carboxypyridine) alone or with 10 or 50γ of synthetic folic acid produced slightly better growth but no improvement in feathering or hemoglobin. When 500γ of α-pyracin were fed with the basal ration alone, no response in growth, hemoglobin, or feathering was noted (Group 14).

Neither *p*-aminobenzoic acid nor a vitamin B_{10} and B_{11} concentrate gave a significant supplementary effect in the presence of an adequate amount of synthetic folic acid. Further comparison of the addition of vitamin B_{10} and B_{11} preparations without added folic acid (Groups 19 and 21) shows clearly the lack of correlation between chick growth and the microbiological activity. Chicks in Group 19, which received in the supplement less than 5γ of "folic acid" (as measured microbiologically after acid hydrolysis, *8*), per 100 grams of ration, grew as well, if not better, than the chicks in Group 20, which received a supplement containing 61γ of "folic acid" per 100 grams of diet.

---

[1] Published with the approval of the director of the Wisconsin Agricultural Experiment Station. The study was supported in part by grants from the Wisconsin Alumni Research Foundation and Swift and Company.

The authors thank Dr. B. L. Hutchings, Lederle Laboratories, Inc., Pearl River, New York, for supplying synthetic folic acid; Dr. J. J. Pfiffner, Parke Davis and Company, for pure isolated vitamin B_c; Merck and Company, Inc., Rahway, New Jersey, for crystalline vitamins; The Wilson Laboratories, Chicago, for whole liver powder and liver fraction L; Wilson and Company, Inc., Chicago, for gelatin; Sharp and Dohme, Inc., Glenolden, Pennsylvania, for sulfasuxidine; Abbott Laboratories, North Chicago, for Haliver oil; E. I. Du Pont de Nemours and Company, Inc., New Brunswick, New Jersey, for vitamin D_3; and Mr. J. Kamhi for his assistance.

[2] Synthetic folic acid was originally called *L. casei* factor.

[3] "Folic acid" (in quotes) is used throughout the paper to designate the microbiological activity of a material when compared to synthetic folic acid on a weight basis (*7*).

TABLE 1

RESULTS OF FEEDING SYNTHETIC FOLIC ACID AND RELATED COMPOUNDS TO CHICKS

No.	Supplement per 100 grams ration	No. chicks	Av. wt. grams 4 wks.	% B_{10}*	Gram % Hb ±1	Ht %†
1	None	18	150	40	6.6	20
2	10γ synthetic folic acid	17	215	65	8.4	
3	15γ " " "	6	205	85	8.3	
4	25γ " " "	17	250	90	8.4	26
5	50γ " " "	12	285	100	9.0	27
6	100γ " " "	5	250	100	8.9	
7	300γ " " "	6	260	100	8.1	26
8	10γ vitamin B_c	6	180	55	8.6	
9	25γ " "	6	225	90	8.8	
10	25γ synthetic folic acid + 100 mg. vitamin C	6	290	95		
11	25γ synthetic folic acid + 10 grams whole liver powder	6	275	100	8.5	28
12	25γ synthetic folic acid + 5 mg. P.A.B.A.	6	250	90		
13	50γ a-pyracin	6	185	45		
14	500γ a-pyracin	12	155	40	6.6	
15	50γ a-pyracin‡ + 10γ synthetic folic acid	6	235	45	8.7	
16	50γ a-pyracin + 50γ synthetic folic acid	6	260	100	8.7	
17	Vitamin B_{10} and B_{11} prep.§ ≅ 5% liver L (8γ "folic acid")	18	260	90	9.1	
18	Vitamin B_{10} and B_{11} prep. ≅ 5% liver L (8γ "folic acid") + 100γ synthetic folic acid	6	270	100	8.7	30
19	Vitamin B_{11} prep.‖ ≅ ½% yeast extract (4.7γ "folic acid")	6	240	30		
20	Vitamin B_{11} prep. ≅ ½% yeast extract + 10γ synthetic folic acid	6	200	65		
21	Vitamin B_{10} prep.¶ ≅ ½% yeast extract (61γ "folic acid")	6	225	95		

* 0 = very poor; 25 = poor; 50 = fair; 75 = good; 100 = very good.

† See (*8*) for method used to determine hematocrit per cent.

‡ a-pyracin was obtained through the courtesy of Dr. Karl Folkers at Merck and Company, Inc.

§ Prepared following the direction for the superfiltrol eluate from liver fraction L (*3*).

‖ Vitamin B_{11} preparation No. 284–5 was made by autoclaving Difco Yeast Extract in 1 N/KOH for one hour at 15 lb.

¶ Vitamin B_{10} preparation No. 208 was made by treating Difco Yeast Extract with chicken pancreas and incubating at 37° for 70 hours at pH 7.

When sulfasuxidine (succinylsulfathiazole) was included in the basal diet, the chicks receiving no supplement developed a more severe deficiency, and under these conditions 25γ of synthetic folic acid per 100 grams of diet did not give a complete response. Fifty micrograms of synthetic folic acid were not as effective in the ration containing 1 per cent of sulfasuxidine as in the diet containing 0.5 per cent of the sulfa drug. A comparison of the activity of synthetic folic acid with and without the addition of 1 per cent sulfasuxidine in the diet (Fig. 1) indicates that folic acid is about three times as effective without the drug.

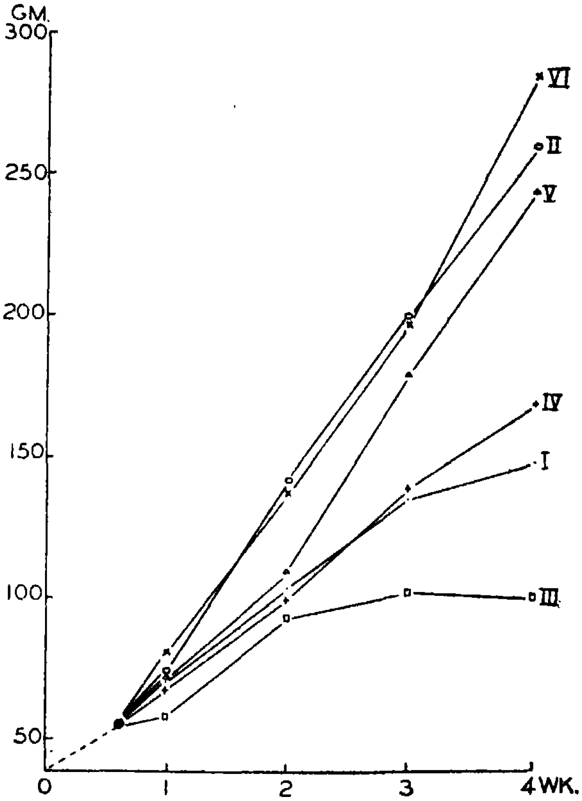


FIG. 1. Activity of synthetic folic acid with and without sulfasuxidine. I = basal ration; II = basal ration + 25γ per cent synthetic folic acid; III = basal ration with 1 per cent sulfasuxidine; IV = III + 25γ per cent synthetic folic acid; V = III + 50γ per cent synthetic folic acid; VI = III + 100γ per cent synthetic folic acid.

Discussion. The results presented here clearly demonstrate that chicks given our basal ration show significant responses in growth, feathering, and hemoglobin formation when 25γ of synthetic folic acid are given. It is still important to decide whether the compound functions directly to produce all these responses or whether the activity may be indirect to some extent. In fact, the increased requirement with the sulfasuxidine suggests some degree of indirect activity. The reason the third *L. casei* factor and the Texas folic acid preparation appeared to be inactive in our earlier studies (*4*) may now be explained on the basis of the increased requirement of folic acid in the presence of sulfasuxidine.

The existence of microbiologically inactive compounds which produce feathering (vitamin B_{10}) and growth (vitamin B_{11}), of highly active synthetic folic acid, and of preparations with high bacterial potency but relatively little chick activity makes it necessary to determine which or how many of these compounds are used directly and the possible interrelationships between these compounds.

Summary. The addition of 25γ of synthetic folic acid per 100 grams of our basal ration prevents the reduced growth, poor feathering condition, and low hemoglobin and hematocrit values consistently obtained when the basal ration is fed to chicks. More than 25γ are needed when the diet contains sulfasuxidine. Evidence for the possible indirect action of folic acid is summarized.

Vitamin C or whole liver powder gives a slight response in the presence of adequate amounts of synthetic folic acid.

References

1. Angier, R. B., Boothe, J. H., Hutchings, B. L., Mowat, J. H., Semb, J., Stokstad, E. L. R., SubbaRow, Y., Waller, C. W., Cosulich, D. B., Fahrenback, M. J., Hultquist, M. E., Kuh, E., Northey, E. H., Seeger, D. R., Sickels, J. P., and Smith, J. M., Jr. *Science*, 1945, **102**, 227.
2. Briggs, G. M., Jr., Luckey, T. D., Elvehjem, C. A., and Hart, E. B. *J. biol. Chem.*, 1943, **148**, 163.
3. Briggs, G. M., Jr., Luckey, T. D., Elvehjem, C. A., and Hart, E. B. *J. biol. Chem.*, 1944, **153**, 423.
4. Briggs, G. M., Jr., Luckey, T. D., Elvehjem, C. A., and Hart, E. B. *J. biol. Chem.*, 1945, **158**, 303.
5. Campbell, C. J., Brown, R. A., and Emmett, A. D. *J. biol. Chem.*, 1944, **154**, 721.
6. Hutchings, B. L., Stokstad, E. L. R., Bohonos, N., and Slobodkin, N. H. *Science*, 1944, **99**, 371.
7. Luckey, T. D., Briggs, G. M., Jr., and Elvehjem, C. A. *J. biol. Chem.*, 1944, **152**, 157.
8. Luckey, T. D., Briggs, G. M., Jr., Moore, P. R., Elvehjem, C. A., and Hart, E. B. *J. biol. Chem.*, in press.
9. O'Dell, B. L., and Hogan, A. G. *J. biol. Chem.*, 1943, **149**, 323.

Fluctuations in Abundance of Marine Animals

Martin D. Burkenroad

Bingham Oceanographic Laboratory, Yale University, and The Chesapeake Bay Fisheries Commission

The starfish (*Asterias forbesi* Desor) is at times a source of serious injury to the mollusk fisheries of southern New England. The precise extent of the damage done by this pest is extremely difficult to assess, but the cost of efforts at control provides some indication of the magnitude of the problem. The oyster growers of Connecticut alone are conservatively estimated to spend an average of $100,000 per year in combating starfish on their private beds; and approximately $75,000, independent of Federal grants, was paid out for the removal of starfish from public bottoms by the authorities of Massachusetts and Rhode Island during the decade from 1932 to 1942.

It has long been recognized by oyster growers that the amount of trouble caused by starfish is not constant but rises from time to time to the proportions of a plague. Until the present, however, no attention has been given to the pattern of these fluctuations. Evidence here presented in part (Fig. 1) seems to demonstrate that troughs and peaks of abundance of starfish have alternated at seven-year intervals, since 1852 at least, in synchrony throughout the region from New York to Cape Cod. The regularity of these changes during the past hundred years suggests that potential damage from starfish may be expected to decline to a minimum around 1950 and to increase thereafter to a peak during the years around 1957. It is believed that ability to foretell in a general way the times of danger from starfish may effect considerable direct and indirect savings to the New England oyster industry, by permitting a more efficient planning of the use of vessels, oyster stock, and oyster grounds.

Adequate statistical information upon starfish is not available. Definition of periods of scarcity and of abundance of starfish upon the oyster beds has, nevertheless, been found possible by the systematic employment of semiquantitative data, the value of which for such purposes has not heretofore been generally appreciated. These nonnumerical data are derived from statements concerning relative amounts of trouble with starfish at various points in southern New England, contained in reports of public commissions, trade journals, newspapers, periodicals, private memoranda, etc. As examples of such statements, the *Norwalk Gazette* for 3 July 1858 reports that "the star-fish are eating up the oysters in the beds of New York harbor . . . [and in consequence the] proprietors have petitioned the state to remit the usual taxes . . ."; and the Reports of the Rhode Island Commissioners of Shellfish for 1859 and for 1861 state that "during the past year [1859] a very large quantity of the oysters planted upon the private oyster beds [of Narragansett Bay] have been destroyed by the star fish . . . [so that] the past two years have been . . . years of want . . . ," and that "for some time prior to . . . 1860 the increase of the star-fish had been very rapid, until, in that year, they became so numerous and so destructive as to render an entire abandonment of the ground necessary."

One hundred and eighty-five such statements have been collected, tabulated chronologically, compared, and evaluated in terms of "Many," "Few," etc. Although these evaluations are necessarily subjective, the indications upon which they are based are in general quite unequivocal; and although the reliability of individual indications might be questioned, there is in general a close agreement between independent statements from the same as well as from different parts of New England during the same period. A summary of the evaluations is presented graphically in the lower half of Fig. 1. The upper half of the figure shows the quantities of starfish caught annually by an oyster company in Connecticut, 1892–97, and by one in Rhode Island, 1908–38.

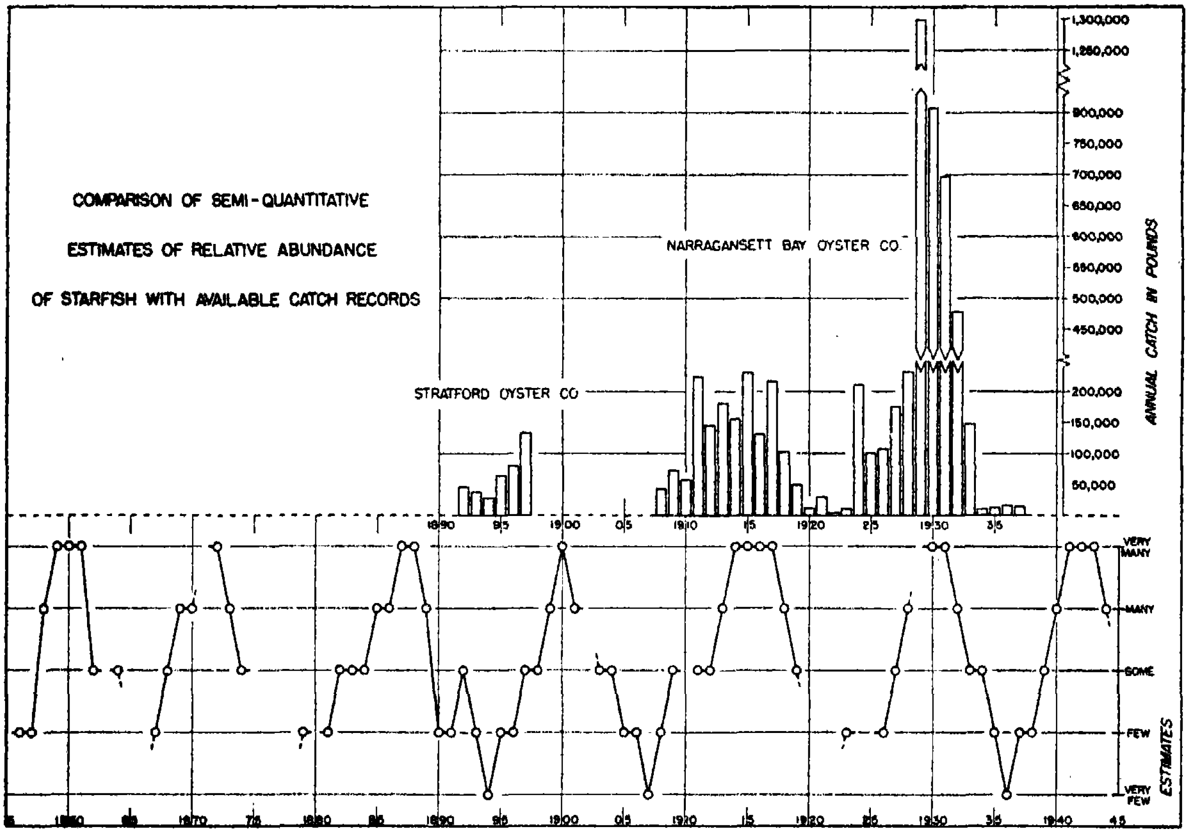


FIG. 1

Nonnumerical data on starfish are obviously incapable of defining absolute differences between different periods or stations of observation, but they do deal directly with immediate trends in the degree of trouble experienced. The available numerical data are for limited times and localities only and are not corrected for variations in fishing effort, but they do show clearly that there were great and real changes in the quantity of starfish taken from certain oyster beds. The general agreement between the two types of record seems to justify the conclusion that cyclical changes in the population of starfish have actually occurred. It will be seen from Fig. 1 that these changes have been of such regularity that, by successively adding 14 years to a given date (for example, 1858, 1872, 1886, 1900, 1914, 1928, 1942), the entire record can be traversed without loss of phase. The long (14-year) period of the cycle, its high degree of regularity, and the fact that the cycle concerns a marine invertebrate, are all unusual features.

The data here described do not allow distinction to be made between changes in abundance and changes in distribution, but there is considerable evidence to support the hypothesis that there is a close relation between amount of trouble with starfish and magnitude of the general population of this animal. Calculations concerning the stock of starfish suggest that the biomass during average peak periods may be of an order 20 times as great as that during average troughs; and that the peak populations may reach or surpass the tremendous average density of 1,000 pounds per acre on the half million acres where the species is common in southern New England (a density of about the same order as that during the unique outbreak of the same species in Chesapeake Bay in 1936–38). Knowledge of this regular pattern of violent changes in the stock has opened the way to new conceptions of the natural history of the starfish and the problems of its control, to be reported in forthcoming publications.

Lack of long-term continuous statistics upon abundance is not limited to such relatively obscure forms as the starfish. Indeed, available numerical information by no means excludes even the possibility that regular patterns of natural fluctuation might exist in various commercially important populations, such as those of crab, lobster, shad, croaker, etc. For example, the catastrophic declines in production which have been a repeated feature of the modern crab fishery in Chesapeake Bay have often been interpreted as the result of overexploitation; and the statistics of the shad catch are at present generally regarded as showing that overintensive fishing has been the major cause of a disastrous reduction in the stock. However, surveys now in progress, similar to that described above for the starfish, suggest that periodic scarcities of crabs and of shad have occurred throughout the history of these fisheries;[1] and it is by no means certain as yet that these changes have either been closely correlated with human activities or entirely irregular in period.

The dynamics of American marine ecosystems are little understood. For example, it is not known whether Chesapeake Bay could simultaneously support stocks of all of the various fishery animals at the maximum levels to which they have individually attained at various times. Clues to significant population interrelationships might conceivably be obtained from comparison of the changes in abundance, both local and general, of a wide variety of forms over long periods of time. Nonnumerical data may afford a means of making such comparisons, which are otherwise not feasible in any near future.

Hyaluronidase Inhibition by Sodium Salicylate in Rheumatic Fever

FRANCISCO GUERRA
Instituto Nacional de Cardiología, Mexico

The predominating role of the mesenchyme tissues in rheumatic fever and the permeability changes that are known to occur in its evolution point to interrelationship of several characteristics of rheumatism and the spreading factors of connective tissue, whether of bacterial or endogenous origin. On the other hand, no clear explanation has been presented for the mechanism of sodium salicylate or related drugs in rheumatic fever, although the arresting of the inflammatory process and the regression of symptoms are not the effect of bacteriostatic action.

Rheumatic fever is a disease of the mesenchyma characterized not by the virulence of the etiologic organism but by its invasiveness, especially in youth. In accordance with Bensley (*1*), the connective tissue in formation passes through the following stages: edema → gelatinous ground substance → argyrophilic fibers → collagen in the adult stage. In the early stages, diffusibility in the ground substance is favored to the extreme, while the collagenous fibers that characterize adult connective tissue retard diffusibility, the ground substance having been replaced by the fibers. The importance of the spreading effect of hyaluronidase on connective tissue is based on the observation of Meyer and Palmer (*6*) who pointed out that the principal substrate of connective tissue and mucoid structures is hyaluronic acid, which composes practically entirely the regions affected by rheumatism, such as articulations and synovial fluid.

Durán-Reynals (*3*), McClean (*5*), Kendall and associates (*4*), and especially Crowley (*2*) have observed that several microorganisms including more than 200 strains of hemolytic streptococci produce or possess hyaluronidase. The hyaluronidase of bacterial origin or from testicular extract, used in our work in a 1-per cent dilution, with Evans blue 1-per cent solution in humans or India ink 1:2 for rabbits, increases the spread of dyes by means of enzymatic activity hydrolizing the hyaluronic acid present in the ground substance, decreasing the viscosity, and thus favoring the passage of liquids, exudates, and pathogenic microorganisms. Its action may be divided into the following stages: (a) decreasing acetic acid coagulation of the substrate, (b) decreasing viscosity, and (c) hydrolizing of hyaluronic acid with the release of glucosamine and reducing substance.

In a total of 96 experiments on 24 albino rabbits it was observed that the spread area of India ink with hyaluronidase was six times greater than with saline. The oral or intravenous administration of sodium salicylate inhibited by 57 to 66 per cent the spreading effect of hyaluronidase; the degree of inhibition varied with the dose of salicylate administered. Sulfadiazine did not reduce the activity of hyaluronidase, but appeared to enhance its effect with inflammatory reactions in the center of the area in several groups.

---

[1] Thus, in the case of the Hudson shad run, what may have been a general scarcity during the 1830's has been noted by DeVoe (*The market assistant*, 1867, p. 200): "This shad-fishery [Cortelyou's fyke-nets in the Narrows] has been gradually decreasing since the year 1824, so that now [1838] it is scarcely worth attending to. . . . All the fisheries in New York harbor are nearly destroyed and the fish which now supply the markets of the city are brought from the distance of sixty, eighty, and even a hundred miles. . . ." Again, during the latter third of the century, "Great complaint and dissatisfaction were encountered everywhere [on the Hudson], the fisheries having fallen off immensely. . . . There never before had been so few shad taken and the retail price in market rarely fell below seventy-five cents for fish which ten years ago [1858] were sold for ten and fifteen cents apiece . . ." (*Report of the Commissioners of Fisheries of New York*, 1869, pp. 9–10). During the late 1870's and 1880's there followed what appears to have been a gradual renewal of abundance, which was credited at the time to hatchery operations stimulated by the preceding scarcity. A fresh decline and a fresh recovery have followed in this century.

These results were reproduced in a total of 144 experiments on 36 normal male and female adults and children employing the same criteria of the spreading effect of Evans blue with hyaluronidase reached by intravenous injections of 275 γ/cc. of sodium salicylate in plasma and then measuring the areas after 24 hours of the intradermal injection of the dye with the enzyme. Intradermal injections on individuals, either with active rheumatic fever or having suffered it gives unique reactions with enormous diffusion of the dye and local edema that sometimes occupies the arm injected with hyaluronidase. The salicylate also inhibits the enzyme in those cases and reduces its spreading effect on connective tissue. These types of allergic reactions to hyaluronidase were also observed in one male who suffered exanthematic typhus.

The evidence found in normal rabbits and humans, as well as in individuals who have latent or active rheumatic fever, indicates the important role of hyaluronidase in its mechanism and the inhibitory effect of sodium salicylate as a typical antirheumatic drug.

References

1. Bensley, S. H. *Anat. Rec.*, 1934, **60**, 93.
2. Crowley, N. *J. Path. Bact.*, 1944, **56**, 27.
3. Duran-Reynals, F. *Bact. Rev.*, 1942, **6**, 197.
4. Kendall, F. E., Heidelberger, M., and Dawson, M. H. *J. biol. Chem.*, 1937, **118**, 61.
5. McClean, D. *J. Path. Bact.*, 1941, **53**, 156.
6. Meyer, K., and Palmer, J. W. *Amer. J. Ophthal.*, 1936, 859.

Science Legislation

H.R. 6448

Howard A. Meyerhoff
Executive Secretary, AAAS, Washington, D. C.

The passage of a national science foundation bill in this session of Congress was seriously jeopardized by the introduction of a bill in the House of Representatives by Rep. Wilbur D. Mills of Arkansas 15 May. The bill was referred to a subcommittee of the Interstate and Foreign Commerce Committee of the House, which has since held hurried hearings. Whether the subcommittee will refer the bill to another committee, whether it will report the bill out of committee in the near future, or whether it will let the bill die in committee is not known at the present time.

However, the whole procedure in this, the first introduction of the House of Representatives to national science foundation legislation, is so reminiscent of that which surrounded the introduction of the May-Johnson bill that readers of *Science* need to be informed about it.

The facts surrounding the introduction of the bill and the subsequent hearings bear the following relations to legislation which is pending in the Senate.

In the first place, the bill was handed to Representative Mills by an ardent and unreconstructed proponent of the old—and abandoned—Magnuson bill, S. 1285. This same proponent generously volunteered to arrange for witnesses of his selection to appear at hearings which were held without the knowledge of the departments of government ordinarily consulted in such matters, for example, Interior, Commerce and Agriculture.

Needless to say, none of the sponsors of S. 1297 (the Kilgore bill) were among the few who testified: None of those groups who merely sought sound legislation without favoring either the Kilgore bill or the Magnuson bill was represented. On the other hand, influential opponents of the Kilgore bill and the more recent Kilgore-Magnuson bill (S. 1850) were among those who testified.

The proponent of H.R. 6448-S. 1285 is not a scientist, nor is he qualified to speak for the great body of American scientists. Somehow, through Rep. Mills he obtained the introduction of a bill for which he was prepared to secure expert testimony in advance. In this high-minded and democratic manner the House has obtained its initial introduction to the National Science Foundation.

It is perhaps fortunate that the week which was scheduled to be "Science Week" in the Senate (See *Science,* 1946, **103**, 589) was lost to more pressing labor problems, for although the delay may mean that a national science foundation will not be created in 1946, at least scientists will have time to acquaint their congressmen with their views. If there has been any doubt that this must be done in the minds of any individual scientist, the introduction of H.R. 6448 should dispel it. Science legislation is "on the loose."

Do scientists want what the National Association of Manufacturers, or some few persons whether they are scientists or not, believe that they *should* have? The 232 members of the AAAS Council who favored action to assure passage of S. 1850 don't believe so. The many members of the Association who have written and spoken to the writer don't believe so.

If individual scientists are to get what they *do* want, they must become articulate. They must become more vocal with their congressmen than the willful individuals or the reactionary organizations who may yet lobby objectionable and obstructive legislation onto the statute books,—and who are evidently determined to do it!

The following people testified on 28 May in connection with the bill **before the Subcommittee on Public Health of the Interstate and Foreign Commerce Committee: Rep. Thomas A. Jenkins, of Ohio; Dr. Isaiah Bowman, president of Johns Hopkins University; Rep. Wilbur Mills, of Arkansas; Mr. Robert T. Patterson, Secretary of War; Dean C. D. MacQuigg, of Ohio State University; Dr. Homer Smith, of New York University College of Medicine; Dr. R. E. Dyer, of the National Institute of Health; Dr. Vannevar Bush, director of the Office of Scientific Research and Development; Mr. W. J. Kenney, Assistant Secretary of the Navy, and Mr. John Victory, executive secretary of the National Advisory Committee for Aeronautics.**

The hearings continued on 29 May, when the following testified: Mr. George E. Folk, of the National Association of Manufacturers; Dr. Detlev Bronk, director of the Johnson Research Foundation of the University of Pennsylvania, and Dr. A. N. Richards, vice-president of the University of Pennsylvania and chairman of the Committee on Medical Research of the Office of Scientific Research and Development. Dr. Bronk and Dr. Richards spoke in broad terms which would apply equally to H. R. 6448 or S. 1850.

Dr. E. U. Condon, director of the National Bureau of Standards, also testified on 29 May, but opposed the Mills bill, pointing out that it was practically identical with the Magnuson Bill, which contained features unsatisfactory to the majority of American scientists. Dr. Condon spoke both for himself and for Secretary Wallace, whose written statement he read. Secretary Wallace pointed out in his statement why the compromise Senate bill S. 1850 was a better bill than the proposed legislation in the House, based as it is on the older discarded Magnuson bill.

As the situation now stands, all of these people are subject to recall to testify before the committee again at its pleasure. It is hoped that *Science* can print excerpts from the testimony referred to above in the issue of 14 June.

Scientists Divided

Watson Davis

Director, Science Service, Washington, D. C.

Another science foundation bill to provide federal funds for scientific research is making a bid for Congressional action, although a compromise bill, S. 1850, worked out by months of Senate hearings to reconcile viewpoints among scientists has already been reported out of committee (19 March) and awaits a place on the Senate calendar (*Science,* 1946, **103**, 382; 589).

This new bill, H.R. 6448, introduced by Rep. Wilbur D. Mills of Arkansas 15 May, has had two days of hurriedly called hearings, at which Dr. Vannevar Bush, director of the OSRD gave it his blessing as "fulfilling the needs of the country better than any other piece of legislation I have seen for the purpose."

A statement from Secretary of Commerce Wallace, presented by Dr. E. U. Condon, Bureau of Standards director, declared the new bill "will not foster the progress of free scientific inquiry" and "will lead to an increasing monopolization of science by a small clique and operate to the detriment of small and independent business in this country."

The Mills bill puts the control of the proposed national science foundation in the hands of a part-time board, whereas the Senate bill (1850), compromising earlier Magnuson and Kilgore bills, provided a full-time Presidentially-appointed administrator with a part-time advisory board.

The new bill continues the present general practice under which commercial patent rights go to the inventor, meaning generally the institution where the research is done, with the government getting only the right to use the results for its own purposes. The Senate bill (1850) provides generally that federally-supported research shall be freely available to the public.

The new bill does not distribute funds geographically or to non-profit organizations, and it does not provide for support of social science research.

A National Association of Manufacturers representative, George E. Folk, testified for the new bill, and so did Prof. Homer W. Smith, New York University physiologist, who has acted as secretary of the Committee Supporting the Bush Report.

Last November this Committee, headed by President Isaiah Bowman of Johns Hopkins University, attacked the Kilgore bill and supported the Magnuson bill. After the compromise S. 1850 bill had been developed, this group as recently as 23 April on behalf of 5,000 scientists, appealed to Congress for its enactment.

The stand of Dr. Bush, Prof. Smith and others upon the Mills bill seems to again divide those who favor some sort of National Science Foundation.

News and Notes

The Senate unanimously passed the McMahon bill for the domestic control of atomic energy in a surprise move Saturday afternoon 1 June. The Selective Service bill which was to have been debated on Saturday was deferred until Monday, so that administration leaders had an opportunity to put the position of the United States on record before its policy is presented to the United Nations Atomic Energy Commission on 14 June. The McMahon bill now goes to the House of Representatives where it will be referred to the House Military Affairs Committee. (A detailed analysis of the provisions of the McMahon bill was published in *Science*, 1946, **103**, 133.) Two amendments were made on the Senate floor. One, sponsored by the McMahon Committee, prohibits any person from manufacturing or acquiring fissionable material or from using atomic energy in a weapon without a license from the Atomic Energy Commission. The other amendment, offered by Senator Joseph C. O'Mahoney of Wyoming, would prohibit any person or corporation associated with wartime atomic bomb projects from asserting claims to any land which might contain raw materials for the manufacture of fissionable products.

In his speech for the bill Senator McMahon emphasized the biological and medical application of radioactive isotopes, although he also mentioned peacetime uses of nuclear energy for power.

Senator Vandenberg said that he hoped that the Senate action represented a transitional phase of atomic control and that this control would soon pass into the hands of the United Nations Commission.

Alexander G. Langmuir, a member of the Commission on Acute Respiratory Diseases at Fort Bragg, North Carolina, under the Army Epidemiological Board, has been appointed an associate professor in the Department of Epidemiology of The Johns Hopkins School of Hygiene and Public Health.

John Chipman, professor of process metallurgy at the Massachusetts Institute of Technology since 1937, has been appointed head of the Institute's Department of Metallurgy. Dr. Chipman will succeed Robert S. Williams, who retires on 1 July after 44 years of service.

Reynold C. Fuson, University of Illinois, will receive the honorary degree of D.Sc. at Montana State University's commencement exercises on 10 June. Dr. Fuson was graduated from Montana State University in 1920 and has been on the faculty at the University of Illinois since 1927.

Announcements

Edith S. Clements has presented to the Department of the Natural Sciences of Santa Barbara College a large collection of literature and maps and a quantity of laboratory instruments selected from the library and laboratory of her late husband, Frederic E. Clements. The material constitutes the Frederic E. Clements Memorial, dedicated to the encouragement of the study of plant ecology.

Particularly useful is the large collection of pamphlets and reprints from scientific journals collected throughout the long career of the Drs. Clements. These comprise a high percentage of the widely scattered literature on plant ecology, the Scandinavian, Swiss, and Slavic writings being particularly well represented. Also quite valuable is the great mass of descriptive literature dealing with the vegetation of North America. Probably between 3,000 and 4,000 items, ranging from reprints to whole volumes, many of them not yet classified, are included in the library collection.

Dr. Edith Clements has expressed a strong desire that her gift be utilized to the fullest extent, and to this end it is being organized for class use in courses in plant ecology and as a reference collection for research. It will also be available for the use of visitors and for interlibrary loan except in the case of fragile items. The map collection and the instruments will serve as the nucleus of the teaching aids and materials to be employed in a series of courses in plant ecology.

Under a contract with the War Department, a research program concerned with the development of standard laboratory methods for evaluating rat-repellent substances is now getting under way at the University of Pittsburgh. The program is sponsored by the Office of the Quartermaster General. Wayne Dennis, head of the Department of Psychology, is chairman of the advisory committee for the project, other members of the committee being Robert A. Patton, lecturer in psychology, and Roger W. Russell, assistant professor of psychology. Lawrence M. Stolurow has been appointed research psychologist for the project.

Rohrer, Hibler, and Replogle, consulting psychologists, announce the following additions to the staff: Edward M. Glaser, Los Angeles office; Mack T. Henderson and Ellwood W. Senderling, Chicago office; Richard W. Wallen, Cleveland office; and J. Watson Wilson, New York office.

The American Meteorological Society, through its president, H. G. Houghton, of Massachusetts Institute of Technology, wishes to call to the attention of American colleges the fact that a large number of carefully selected college students were given training in professional meteorology at a few selected universities in this country, preparatory to their employment by the Army and Navy Meteorological Services. A number of these men, before entering the meteorological field, had done a considerable amount of graduate work in physics, chemistry, biology, engineering, geology, etc. and are now available for teaching and research in these fields.

In most of our colleges which offer nonprofessional courses in meteorology to meet the needs of students in geography, geology, and in agricultural subjects, it has been standard practice to have these nonprofessional courses taught by members of various departments. The return of many of the professionally trained service meteorologists offers an opportunity for our colleges to obtain the services of instructors who are capable of doing professional work in Departments of Physics, Chemistry, Geology, etc. and who at the same time are qualified, as experienced and trained professional meteorologists, to present stimulating nonprofessional courses in meteorology on a somewhat higher plane than may have been possible in the past.

The Society is anxious to cooperate with American colleges in providing information concerning these returning weather officers that might be helpful in placing them in suitable teaching positions. To that end, files have been kept which contain detailed information on the education and practical experience of these men.

Inquiries may be directed to the Executive Secretary, American Meteorological Society, 5 Joy Street, Boston 8, Massachusetts.

Word has been received from China regarding the last years of Prof. Amadeus W. Grabau, whose death occurred 20 March 1946 in Peiping (*Science,* 1946, **103,** 534). Prof. Grabau became a resident of China in 1920 and was, from that time on, chief paleontologist of the National Geological Survey of China and concurrently professor of paleontology in the National University of Peking. In 1937, when the Japanese took Peiping and North China by force, Prof. Grabau had been unable to leave that city because of illness and lack of communication facilities. Shortly afterward, the Geological Survey established its new headquarters in Chungking while the National University of Peking was forced to move to Kunming (Yunnan). Having been prevented from joining either of the two institutions, he remained in the old Chinese capital, continuing with his reading and writing. Shortly before the Sino-Japanese conflict he began researches on his "pulsation theory," and during a period of five or six years he completed four large volumes on *Paleozoic formations in the light of the pulsation theory,* which were published by Henri Vetch in Peiping. The last volume appeared in 1938, when fierce battles were being fought both in North and Central China. Following Pearl Harbor in 1941, he was interned by the Japanese, who housed him in the old British Embassy in Peiping. His health began to decline, and his mind became enfeebled. After the Japanese surrender, the authorities of the Geological Survey moved him to their premises at No. 3, Fengsheng Hutung, where he died at the age of 75.

The Department of Geography, Northwestern University, announces a graduate field course to be given 26 August to 28 September. The field centers on Lannon, Wisconsin, 15 miles northwest of Milwaukee, an area containing examples of virtually every glacial form. The course will be limited to 20 students. For further details address: Secretary, Department of Geography, Northwestern University, Evanston, Illinois.

Karl v. Frisch, professor of zoology at the University of Munich and a native of Austria, has written as follows in a letter dated 14 January 1946, from St. Gilgen (Salzburg), Brunnwinkl, in the Austrian Alps:

> . . . work has never stopped in our laboratory. Only since the destruction of buildings has work become nearly impossible in the Munich Institute. I evacuated before this happened and for several years have carried on my scientific work nearly exclusively here on our old farm. To Munich I go only occasionally, for administrative purposes and discussions with my co-workers. Classes have not yet begun. . . .
>
> I have only partial information on my colleagues. . . . When the bomb attacks became too bad, (Alfred) Kühn transferred the Kaiser Wilhelm Institute for Biology to Hechingen. He has now moved the Institute to Tübingen, where he has also taken on the direction of the Zoology Department of the University. As you know, many departmental headships have become vacant due to dismissal of their incumbents. (Otto) Koehler (formerly Königsberg) was in Denmark when the (Russian) occupation came. I have not heard of him since. Goetsch is in Austria and I hope to see him within a few days. He was last in Breslau. Buddenbrock, who was in Vienna, cannot go back there since he is German. I understand that he is to go to Heidelberg where (Paul) Krüger has been dismissed. It is not yet decided who will take Seidel's position in Berlin. He has been dismissed. Hartmann lived on his farm in the Bavarian Alps. Perhaps he will return to the Kaiser Wilhelm Institute. It is terribly sad that (Fritz) Wettstein died of the flu in Trins without any medical care. Renner is well. A few days ago I received a letter from him from

Jena. (Otto) Mangold too is one of those who were dismissed.

. . . I am much handicapped in my work by the loss of my scientific library, particularly reprints. It would be a great help if you on occasion (when it is possible to mail printed matter) could see to it that I were sent papers on the fields of sensory physiology, psychology, and apiculture.

Last summer I was much occupied again with the ''language'' of bees. Very unexpected results have turned out. . . .—*Curt Stern* (University of Rochester).

Elections

The American Academy of Arts and Sciences closed its 166th year on 8 May with the election of new fellows and seven honorary members. The scientists among the new members include: James Gilbert Baker, Harvard College Observatory; John Landes Barnes, head of the Department of Applied Mathematics, Tufts College; Subrahmanyan Chandrasekhar, professor of theoretical astrophysics, Yerkes Observatory; Lee Alvin DuBridge, head of the Department of Physics, University of Rochester; Julius Adams Stratton, professor of electrical engineering, Massachusetts Institute of Technology; Paul Doughty Bartlett, associate professor of chemistry, Harvard University; Walter Hugo Stockmayer, assistant professor of chemistry, Massachusetts Institute of Technology; William Loren Batt, president of S.K.F. Industries, Washington, D. C.; Howard Wilson Emmons, associate professor of mechanical engineering, Harvard University; Roland Frank Beers, research associate in geology, Massachusetts Institute of Technology; Cornelius Searle Hurlbut, Jr., associate professor of mineralogy, Harvard University; Ralph Erskine Cleland, head of the Department of Botany, Indiana University; George Wells Beadle, professor of biology, Stanford University; James Lee Peters, curator of birds, Museum of Comparative Zoology, Harvard University; Kenneth David Roeder, assistant professor of zoology, Tufts College; John Franklin Enders, associate professor of bacteriology and immunology, Harvard Medical School; Charles Alderson Janeway, assistant professor of pediatrics, Harvard Medical School; Siegfried Josef Thannhauser, clinical professor of medicine, Tufts College; Stanley Smith Stevens, associate professor of psychology and director of the Psycho-Acoustic Laboratory, Harvard University; Otto Eduard Neugebauer, research professor in the history of science, Brown University; Jan Hendrik Oort, director, Leiden Observatory, Holland; Bertil Lindblad, director, Stockholm Observatory, Sweden; and Rudolf Florin, professor and director Hortus Bergianus, Stockholm.

Howard M. Jones was elected president of the Academy, and Lewis Don Leet, corresponding secretary.

The New Orleans Academy of Sciences held its 93rd annual meeting at Tulane University, New Orleans, 26–27 April. The new officers for 1946–1947 are: J. Nelson Gowanloch, Louisiana Department of Wild Life and Fisheries, president; William T. Penfound, Tulane University, vice-president; Walter G. Moore, Loyola University, secretary; Thomas T. Earle, Newcomb College, treasurer; and Garland F. Taylor, Tulane University, curator.

The retiring president, L. J. Pessin, presided at the general session which was followed by sectional meetings for the presentation of 36 scientific papers.

The Medical Library Association held its 45th annual meeting in New Haven, Connecticut, 25–27 March. The following officers were elected: Walton B. McDaniel, II, College of Physicians, Philadelphia, president; C. Abbott Beling, Newark, vice-president; Heath Babcock, New York State Medical Library, Albany, secretary; and Jurgen G. Raymond, New York Academy of Medicine, New York City, treasurer.

The program featured reports on the Army Medical Library, a symposium on "International Cooperation," and addresses on "Training for Medical Librarianship" and "British Medical Libraries in Wartime."

It was voted to hold the 1947 convention in Cleveland, Ohio, the exact date to be determined later.

The South Carolina Academy of Science held its 19th annual meeting in Charleston, South Carolina, 27 April. The following officers were elected: Velma D. Matthews, Coker College, president; J. E. Copenhaver, Sonoco Products Company, vice-president; and Charles F. Poole, U. S. Vegetable Breeding Laboratory, secretary-treasurer. F. W. Kinard, J. R. Sampey, G. Robert Lunz, Margaret Hess, and F. H. H. Calhoun were elected to the Council.

The meeting, the first since 1941, was attended by more than 100 persons, and 23 papers were presented.

The Crystallographic Society held its spring meeting at Smith College, Northampton, Massachusetts, 21–23 March. The meeting was attended by 50 out of its total of 150 members. The following new officers were elected: M. J. Buerger, Massachusetts Institute of Technology, president; J. D. H. Donnay, The Johns Hopkins University, vice-president; and William Parrish, Philips Laboratories, Inc., Irvington-on-Hudson, New York, secretary-treasurer.

A detailed discussion of the proposed new *Journal of Crystallography* resulted in the adoption of eight tentative resolutions regarding publication, editorship, international representation, etc. These matters will be discussed further by members of the Society, the American Society for X-ray and Electron Diffraction, and British crystallographers and X-ray workers in a conference in London next July, to which scientists from several other countries have been invited.

The secretary was instructed by almost unanimous vote to send the following letter to the President and the Senators on the McMahon Committee:

> A majority of the membership of the Crystallographic Society is in favor of legislation which places control of the atomic energy program in civilian hands.

Proposal for an American Institute of Biology

The formation of an organization to serve the interests of biologists appears to be now on the way to realization. The Executive Committees of the Union of American Biological Societies and of the American Biological Society met at intervals during the past year to discuss problems facing biologists and to consider ways and means for securing more thorough cooperation among them. The matter had already been brought up at an informal gathering called by E. G. Butler, then president of the UABS during the Cleveland meetings of the AAAS, two years ago. Detlev Bronk was asked by the group to collect information for presentation at a later appropriate time. This was decided to be at an open meeting called by the UABS and ABS on the occasion of the recent St. Louis meetings of the AAAS and several of the national societies.

Dr. Bronk presented the need of an institute not only for the assistance of biologists professionally and scientifically but also for studying the problem of securing adequate training for those who plan to take up biology as their life work. He also stressed the need of making the profession of modern biology conducive to attracting the best brains of the country. It is highly desirable to have as close cooperation as possible among all operating organizations. A main feature is the importance of closely relating the proposed Institute with the National Research Council and having the Institute serve to strengthen and supplement the activities of the Council. Several services which such an institute can render are outlined in a recent article in the February issue of the *American Naturalist*. Dr. Bronk also outlined an immediate procedure of having the group already engaged draw up definite plans and secure necessary funds.

Following general discussion it was unanimously voted to have the original Cleveland group, with several others, form an initiating committee to proceed with the development of an American Institute of Biology. This committee is to invite other interested biologists who are in a position to contribute the needed time and energy. The membership of the enlarged committee will be selected with a view toward complete geographical distribution and adequate representation of the principal biological societies.

The meeting then adjourned with expressions of enthusiastic approval of the project as proposed.

Subsequent to the St. Louis meeting, several members of the initiating committee have met, and steps are being taken to secure necessary funds and to prepare tentative plans for organizing.

The project has been presented by R. F. Griggs, chairman of the Division of Biology and Agriculture of the National Research Council, at a recent meeting in Washington, to 26 representatives of the constituent national societies who approved.

At the meeting of the Council of the UABS in St. Louis the following statement was approved by the Council, which comprises 39 national societies:

> To endorse the formation of an organization of biologists on the basis of the two following general propositions:
>
> 1. To provide a means for executing our public responsibilities as biologists and scientists, so that the freedom essential to the progress of science and public welfare will be insured.
> 2. To safeguard the professional interests of biologists and to assist in providing the material means for the promotion of biological research; also to provide such services as may be necessary to facilitate this program.

The statement was presented to several of the societies convening with the AAAS at St. Louis. It was officially endorsed by the Genetics Society of America, the Botanical Society of America, the American Society of Zoologists, the American Microscopical Society, and others. It was also endorsed by the American Association of Anatomists at their Cleveland meeting a week later. At the meetings of the Federation of Experimental Biology held at Atlantic City in February the proposition of an Institute was presented to the American Physiological Society, which passed a resolution recommending such action. Finally, a letter was received expressing the interest of the Biological Section of the Royal Society of Canada in the proposed American Institute of Biology.

It is expected that plans as they are being developed will be presented in the near future, together with a list of members of the initiating committee.—*Robert Chambers* and *J. S. Nicholas.*

Recent Deaths

Louis Slotin, 35, a native of Winnipeg, Canada, died at Los Alamos 30 May, as a result of an accident 21 May while working with fissionable materials. The nature of the accident was not disclosed by N. E. Bradburg, project director, but he credited Dr. Slotin with dispersing the materials at the time of the accident, so that more workers were not affected. Seven other scientists and technicians were hospitalized but are reported to be recovering. Dr. Slotin, who received his Ph.D. from the University of London, went to Los Alamos from Oak Ridge in December, 1944. He had been at Oak Ridge for about a year.

Letters to the Editor

Rains of Fishes—Myth or Fact?

Being particularly interested in all the unusual things that fishes do and that happen to them, I have for over 40 years been collecting and publishing accounts of such matters, from laymen observers, from scientific men, and from my own experience. In all these articles I have sought to evaluate the evidence and to give credence accordingly. My reports are accredited by my scientific colleagues everywhere.

In the *Atlantic* for April 1946, Bergen Evans, professor of English at Northwestern University, writes that ''the little fishes that come in heavy storms are one of the most delightful . . . myths,'' and further on he refers briefly to one report of a ''rain'' in my first article (1921). This particular fall occurred in India in 1830. The English reporter had the 10 Indian farmers who saw it attest their reports in 1-2-3 order before a magistrate, and their accounts are so printed in my article. Of Nos. 5 and 8 Prof. Evans says: ''Some of Dr. Gudger's more reliable witnesses make the interesting point that the fish that descended on them were headless, rotten and partly eaten—suggesting birds to the incredulous, and God knows what (a rain?) to the credulous.''

What Prof. Evans does not note is that these two ''more reliable witnesses'' also state that some of the specimens were ''fresh.'' Furthermore, he also fails to note that, of the eight other (unreliable?) witnesses, five state that they saw the fishes fall, and No. 5 (a ''reliable'' witness above) had a fish fall on his head. Furthermore, three men (including Prof. Evans' No. 5 above) picked up fresh fishes and carried them away. All these and the accounts of 43 other reporters in this article (among them James Prinsep) are disregarded by Prof. Evans. He picked out the evidence he wanted, but was ''incredulous'' of all the other.

In my first article (1921), which seems to be the only one of the four seen by Prof. Evans, I made an attempt to evaluate the evidence. Some accounts were put down as hearsay and some as hearsay pretty well attested. Others come from men who found previously dry receptacles filled with rain water and fishes—among them, James Prinsep (1833), long secretary of the Royal Asiatic Society of Bengal, who ''found a small fish, which had apparently been alive when it first fell in the brass funnel of my pluviometer at Benares, which stood on an isolated stone pillar, raised five feet above the ground in my garden.'' Some of the various reporters saw the fishes fall, and some had the fishes strike their heads or bodies. Among those who did not witness the falls were scientific men of high standing and veracity who, after carefully investigating the alleged rains, accepted the accounts as credible and whose printed word is today accepted by scientific men. Prof. Evans makes no mention of these.

The explanation is to be found in the action of whirlwinds and waterspouts and possibly of strong typhoon and monsoon winds. A ''twister'' or whirlwind starts in front of an approaching storm, and as it gains in size the ''snout'' elongates and approaches the water. This, caught by the whirling wind, rises up in a cone. The two unite, and the swirling column moves along, picking up water, fishes, and any other fairly light objects at or near the surface of the water.

I have seen waterspouts off Beaufort, North Carolina, and numerous ones in the Florida Keys west of Key West. In these latter, on a day in July 1914, at the Marquesas Atoll, a huge waterspout was seemingly headed for the yacht on which I had been left as shipkeeper, but when near at hand it fortunately sheered off and passed by about 100 yards away. To this day I have a vivid recollection of the irresistible power of this whirling wind and water. A natural history correspondent in Louisiana (E. A. McIlhenny, of Avery Island) once wrote me of a small waterspout on a fresh-water distributary in the Mississippi delta, which broke just in front of his fishing boats and then filled boats with water and fishes. He knew of other like phenomena in that region. Such a waterspout might pick up dead fish (if such were present) as well as live ones. Everything movable would be sucked up in the whirling vortex. Furthermore, whirlwinds, originating inland, will not only progress over land, picking up various objects, but over ponds and lakes—becoming waterspouts. As such they will there pick up frogs, fresh-water fishes, snails, etc. and carry these away over the land. Sometimes the fishes are found in a long, narrow, fairly straight row over some distance, evidently having been dropped as the waterspout progressed over the country with lessening speed and carrying power.

When the waterspout or whirlwind, with its load of fishes, breaks, or when these and the typhoon and monsoon winds lose their velocity to a point where their carrying power is less than the pull of gravity on the fishes, water and fishes will fall as a ''rain of fishes.''

In my four collective articles about 78 reports are noted. Their time span is about 2,350 years, and their range in space, the six continents and various islands in the two great oceans. Recorded are rains from Canada (5), United States (17), England (5), Scotland (9), Germany (11), France (1), Greece (1), Faroe Islands (1), Holland (1), India (13), Malaya (2), East Indies (2), Australia (7), South Africa (1), South America (1), Scandinavia (1). These accounts have been collected from works on meteorology, history, travel, and natural history and from various scientific journals, mainly those devoted to natural history in general. These accounts were written by all sorts and conditions of men—ordinary citizens, persons interested in natural history, and scientific men of high reputation for veracity and for accuracy of observation. Among the latter are James

Prinsep, already mentioned (1833); C. W. Grant (1838), of the Bombay Engineers; J. E. Dekay, in his *Fishes of New York* (1861); Pieter Harting (1861); Sir Emerson Tennent, in his *Natural history of Ceylon* (1861); Count Castelnau, the ichthyologist (1861); E. Warren, of the Natal Museum, South Africa (1909); Alexander Meek, of the Dove Marine Laboratory (1918); and J. D. Ogilby (1907) and A. R. McCulloch (1925), well-known Australian ichthyologists. These men not infrequently narrated these accounts before scientific societies and later published in scientific journals.

Most of the nonscientific observers and some of the scientists had no knowledge of what other men in their own lands and especially in foreign countries had seen and written about. Some of the observers had seen the fishes while falling, some had been struck by the fishes, and some had eaten of the freshly fallen fishes. The mass of evidence is as prodigious in volume as it is widespread in time and space. To disregard all this evidence ranging from hearsay to scientifically attested, and to brand as "credulous" all those who, from personal observation or after much study of published accounts, accept much of it as credible, seems, as I wrote in Article I, to indicate a refusal to consider the evidence offered or an inability to evaluate it.

To my very great regret I have never witnessed a rain of fishes, as I have never seen some of the other unusual and extraordinary things about fishes of which I have written in the past 40 years. But if such things have not been physically impossible, and when after careful and critical consideration of the reports (from hearsay to scientific) from widespread sources the world around and from many reputable observers (some known to me personally)—reports which in detail corroborate each other, then I have ample justification for giving them credence, and so I still believe that:

Fishes fall from the sky with rain.

E. W. GUDGER

American Museum of Natural History

Geopathology or Ethnopathology?

In referring to Francis Dieuaide's article (*Science*, 1945, 102, 656), Frederick Sargent, II (*Science*, 1946, 103, 316) states that "geopathology" is really a branch of biometeorology.

Actually, Dr. Dieuaide's "geopathology" has basically very little to do with biometeorology. True, climate, topography, food, and habit are correlative factors in both; however, they are not the principal factors in "geopathology." Dr. Dieuaide, among others, specifically mentions the "effect of social conditions" and "perhaps hereditary racial traits." In this connection it might also be mentioned that it is somewhat puzzling why Dr. Dieuaide appears to infer that hereditary racial traits are only of secondary importance.

Since we have the opinions of a medical man and a biometeorologist, I wonder if it might not be wise to call upon an anthropologist as an arbiter in this argument. I frankly doubt if anyone would care to lead with his chin. The fact remains, as Dr. Dieuaide very correctly pointed out, that "Geopathology is in its infancy." Nevertheless, it is my personal opinion that Dr. Dieuaide's article is laudable, in spite of the fact that a few minor comments appear debatable.

First, I believe that *Natural resistance and clinical medicine*, by Perla and Marmorston (Little, Brown, 1941) covers a good many of the problems mentioned by Dr. Dieuaide. Second, I believe that American medicine has been somewhat asleep in this regard. It had been my good fortune to obtain several papers in Japan prior to the war which dealt with some studies and research in this field. As a matter of fact, the Imperial Japanese Armed Forces collaborated in some of those studies.

Finally, in answer to Dr. Dieuaide's proposed term, "geopathology," I wonder if the term "ethnopathology" might not be more specific.

HERBERT LIEKER

P. O. Box 115, Universal City, California

A New Pennsylvania Meteorite

Recently one of my students, C. R. Bruce, brought to the laboratory for identification a specimen which had been resting in family cupboards for 61 years. The story was that in September 1886 a man was cutting corn on the Deutihl property, two and a half miles southwest of Bradford Woods, or seven miles northwest of Pittsburgh in Allegheny County, Pennsylvania. He heard an explosion and a rushing noise and ran to the home of George Hillman, who, on going to the field, found the specimen imbedded in the road and still warm. It has been in possession of the family ever since and is now owned by Mrs. Charles Amsler of Baden, Pennsylvania.

Inasmuch as it is in private hands, no opportunity has been afforded for detailed study, but preliminary examination indicates that it is a true stony meteorite or aerolite. As such, it is of considerable interest since it is the first recorded aerolite found in Pennsylvania. R. W. Stone (*Meteorites found in Pennsylvania.* Pennsylvania Topographic and Geologic Survey, Bull. G 2, 1932) lists five meteorites found in the state, but all these were of the metallic type, or siderites.

The Bradford Woods meteorite measures 55 × 65 × 85 mm. and weighs 762 grams. It is shaped somewhat like an old-fashioned pan biscuit with one smooth, curved surface like the biscuit top and three more square faces like the broken faces of a biscuit. The surface has the glazed, varnishlike, pitted surface characteristic of meteorites and is nearly black. It would seem that it is a part of a smooth, pebblelike, elliptic body which, as it reached the earth's atmosphere, exploded, the broken surfaces becoming fused and pitted in the rush through the atmosphere.

A freshly broken corner of the mass made it possible to examine its mineral composition. It is made up of fine-grained, greenish, silicate material which is highly birefringent and has a high index of refraction and an obscure cleavage. This is probably olivine. Accompanying the silicate is a small amount (possibly 2 or 3 per cent) of metallic iron, which is also visible on the unbroken surfaces. The specific gravity of the whole specimen is approximately 3.4.

From this preliminary examination it is evident that the meteorite is an aerolite with a small amount of metallic iron and may possibly be classed as an olivine achondrite.

It is hoped that the specimen eventually may be acquired by the Carnegie Museum of Pittsburgh or some other public repository so that a detailed petrographic and chemical study of it may be made.

HENRY LEIGHTON

Department of Geology, University of Pittsburgh

Another Superior Pith for Free-hand Sections

Mention of a pith other than elder (*Science*, 1946, 103, 112) prompts the writer to communicate further information in that respect.

Botanists or plant pathologists in tropical or equatorial regions will find an advantageous substitute to elder pith in cassava (*Manihot utilissima* Pohl). It is even the writer's view that the latter is decidedly superior to the former in several respects.

As in the case of *Tetrapanax papyriferum* Koch (above reference), cassava pith has no vascular bundles or hard tissues. Moreover, when used dry it cuts beautifully under the razor, leaving a sheeny surface very soft to the touch. It can be sectioned very thinly without disintegrating, as does that of elder, in like circumstances.

The reason for this can be found in comparing the texture of both piths. Dried cassava pith ready for use has, in cross-section, cells measuring 160–250 μ by 100–150 μ. The cells are larger in the center than outwards and gradually decrease in size in that direction. In longitudinal section the dimensions are contrariwise uniform and vary throughout from 25 to 60 μ. Thus, were it not that they are organized in a tissue, the cells would be lenticular in shape, whereas elder-pith cells are globular and of dimensions somewhat larger than the above.

Extraction of the pith is quite simple and offers no difficulty whatsoever. Cassava stalks should be chosen straight and when the plants are fully mature. They are cut in lengths of about 30–40 cm. A stick of the diameter of the pith is inserted at one end of the fragment. Pushing the stick forces the pith out at the other end in a contorted rod. When straightened out, the rods are left to dry and are then ready for use. The rods can be obtained of a diameter up to 1.5 cm., but they are more usually of 1–1.2 cm., which is quite sufficient for sectioning with a hand microtome.

For cutting small objects the pith can be carved, while in the hand microtome clamp, similarly to paraffin blocks. The writer has had such satisfactory results with cassava pith that elder pith has been totally discarded.

R. L. STEYAERT

Bambesa, District Uele, Belgian Congo

INDUCTANCE CALCULATIONS SIMPLIFIED

At last, inductance calculations—so important to power, communication, and electrical engineers and those in related fields—have been reduced to simple, *slide-rule* computation.

INDUCTANCE CALCULATIONS

Working Formulas and Tables

By FREDERICK WARREN GROVER, PH.D.
Professor of Electrical Engineering, Union College
Formerly Consulting Physicist,
National Bureau of Standards

In this brand-new book all problems in inductance calculation are made easy and direct. The best single formula (or two for checking) has been chosen for every type of element or coil; and factors corresponding to dimensions of particular elements or coils are provided, so you can find the exact theoretical (not empirical) value by the most simple computations.

Included are tables that save the vast amounts of computation, often with complex mathematical functions, which hitherto have been necessary. Now all problems in inductance calculations can be computed by the use of interpolated values of constants, and even with the more complicated arrangements of conductors, a straight-forward procedure can be outlined.

CHAPTER HEADINGS

General Principles; Geometric Mean Distances; Construction of and Method of Using The Collection of Working Formulas. CIRCUITS WHOSE ELEMENTS ARE STRAIGHT FILAMENTS. Parallel Elements of Equal Length; Mutual Inductance of Unequal Parallel Filaments; Mutual Inductance of Filaments Inclined at an Angle to Each Other; Circuits Composed of Combinations of Straight Wires; Mutual Inductance of Equal, Parallel, Coaxial Polygons of Wire; Inductance of Single-Layer Coils on Rectangular Winding Forms. COILS AND OTHER CIRCUITS COMPOSED OF CIRCULAR ELEMENTS. Mutual Inductance of Coaxial Circular Filaments. Mutual Inductance of Coaxial Circular Coils; Self-Inductance of Circular Coils of Rectangular Cross Section; Mutual Inductance of a Solenoid and A Coaxial Circular Filament; Mutual Inductance of Coaxial Single-Layer Coils; Single-Layer Coils on Cylindrical Winding Forms; Special Types of Single-Layer Coil; Mutual Inductance of Circular Elements With Parallel Axes; Mutual Inductance of Circular Filaments Whose Axes are Inclined to One Another; Mutual Inductance of Solenoids With Inclined Axes, and Solenoids and Circular Coils With Inclined Axes; Circuit Elements of Larger Cross Sections With Parallel Axes; Auxiliary Tables for Calculations With Formulas Involving Zonal Harmonic Functions; Formulas for The Calculation of The Magnetic Force Between Coils; High Frequency Formulas.

Durable cloth binding 6 x 9 295 pages $5.75

SEND FOR YOUR COPY NOW

Use the convenient order form below to obtain your copy of this important new book.

MAIL THIS COUPON

D. VAN NOSTRAND COMPANY, INC.
250 Fourth Avenue
New York 3, New York

Gentlemen:
Please send me .... copies of
INDUCTANCE CALCULATIONS.

Signed ....
Address ....
City .... Zone ...... State ....

SC-6/46

Book Reviews

The endocrine glands. **Max A. Goldzieher. New York: Rudolf Schick, 1945. Pp. 49. $1.20. 5 wall charts, $6.50 ea.**

Dr. Goldzieher has spent much of a long and productive lifetime as an investigator and practitioner of endocrinology. A strikingly large part of his erudition has come to graphic epitomization in a series of five wall charts that set forth much of our fundamental knowledge of the subject. The charts are expounded in an accompanying brochure that does credit to the author but not the publisher: the illustrations are distressingly muddy.

For the most part the text is accurate and clearly expounded. Whether, however, the rather elaborate diagram setting forth glandular relations is more instructive than confusing might be questioned. The picture representing Addison's disease is misleading in that the characteristic pigmentation is exaggerated. Froelich's disease is ascribed to anterior pituitary disorder rather than to its fundamental neural cause. The illustration of the normal thyroid gland is seemingly a poorly executed section of a colloid goiter. Finally, the curious error is made in the text of expressing the output of adrenal steroids in misused terms of gammas instead of milligrams as is correctly done in the chart itself. These are all errors that can be corrected easily in the revised edition to which the material by its general excellence is abundantly entitled. The charts should be of much aid in the teaching of endocrinology.

R. G. Hoskins

Harvard Medical School, Boston

Endocrine man: a study in the surgery of sex. **L. R. Broster. New York: Grune and Stratton, 1945. Pp. xi + 144. $3.50.**

On the internal evidence of Broster's book the author is a naturalist turned surgeon. He writes both as a biophilosopher and as an authority on the subject of the sexual functions of the adrenal glands. In the latter capacity, the work is satisfying, affording, as it does, an excellent epitome of the contributions of himself and colleagues on a difficult subject. The chief adverse criticism that might be offered in this connection is that oversweeping claims are made for the specificity of the fuchsin-dye method for the identification of the sex-hormone-producing cells of the adrenal cortex.

The exposition of the biology of man is less acceptable. Broster plays fast and loose with the concept of instincts. He overfacilely ascribes the impetus of integrative evolution to three "instincts," those for growth, self-preservation, and reproduction. He then further equates growth with the pituitary gland, self-preservation with the adrenal glands, and reproduction with the gonads. While it is true that the pituitary does furnish a growth hormone, it is also true that growth is promoted by numerous other factors. Likewise, preservation is promoted by many other structures than the adrenal glands. On the whole, the book may be rather well characterized in the writer's own words as "a kaleidoscopic picture of impressions gathered in the pursuit of the practical clinical application" (of endocrinology). The story of evolution is interestingly told but leaves the author's amateur standing essentially unimpaired.

R. G. Hoskins

Harvard Medical School, Boston

Transmission lines, antennas and wave guides. **Ronold W. P. King, Harry Rowe Mimno, and Alexander H. Wing. New York: McGraw-Hill, 1945. Pp. xv + 347. $3.50.**

Developments in the field of antennas and transmission lines underwent a marked change during the years from 1930 to 1940. New concepts and new researchers appeared on the scene, impelled by the development of frequencies far above the old range. What had been a purely theoretical field in electromagnetics suddenly became an integral part of the very practical communication and detection devices developed during the course of the war.

This text is the joint effort of three prominent specialists in the field of ultrahigh frequencies. Alexander H. Wing, in the first chapter, skillfully covers the field of high and ultrahigh-frequency transmission lines. Ronold W. P. King covers the next two chapters on antennas and UHF circuits and provides most of the original material. The brief concluding chapter on wave propagation is by Harry Rowe Mimno.

The authors have contributed materially to the rapid development of the field, and much of the material in this book is original. The body of the text consists of the lecture material from a part of the pre-radar course given to officers in the Armed Forces by the staff of the Cruft Laboratory and is very direct in its approach. Mathematical rigor is preserved, but there are several places where a fuller exposition could be justified, especially in the matter of approximations. In addition, some of the conclusions, such as those to be found in the section on Poynting Vector and Effective Cross Section, are not universally accepted, and little or no mention of the other versions is made except in the references.

It must be concluded that this is an advanced text which must be accepted per se by the uninitiated unless they have time to make a careful study of the references. In fact, it is a most unique example of transference of the skill and learning of the authors in a matter-of-fact way to hundreds of clever young men for the very practical purpose of operating radar and similar devices. The results were excellent, and this volume will serve as a standard of comparison for years to come.

A. E. Vivell

Postgraduate School, U. S. Naval Academy

SCIENCE

Vol. 103, No. 2685 Friday, June 14, 1946

Availability of Radioactive Isotopes

Announcement From Headquarters, Manhattan Project, Washington, D.C.

PRODUCTION OF TRACER AND THERAPEUTIC RADIOISOTOPES has been heralded as one of the great peacetime contributions of the uranium chain-reacting pile. This use of the pile will unquestionably be rich in scientific, medical, and technological applications.

Manhattan Project scientific, technical, and administrative personnel have, since the inception of the pile, been cognizant of its peacetime potentialities and have, since the end of the war, been active in attempting to realize these opportunities. Since, however, war-built piles and wartime researches had other objectives, a considerable transition in researches, developments, and operations connected with piles must be effected before the supply of radioisotopes can begin to meet the demand.

Comments on Availability of Radioisotopes

(1) A pile cannot make the extensive variety of radioisotopes producible with the cyclotron because the cyclotron makes use of a much greater diversity in energy and type of nuclear bombarding projectiles. Present piles are copious sources of low-energy neutrons, which can give rise to large yields only of isotopes produced by (n,f) and (n,γ) processes.

(2) Although large numbers of radioisotopes are produced in abundance by the fission of uranium in the piles, their availability is limited by the difficulties encountered in isolating them. It has not yet been found feasible to remove individual fission products from waste solutions of the plutonium extraction process. Most of the fission products being made available are not salvaged by-products of the plutonium process but are in each case items requiring special production from unprocessed irradiated uranium.

(3) Most of the radioisotopes in greatest demand, such as C 14, S 35, and P 32, must be produced by the irradiation of materials foreign to the pile. Existing piles were not designed for this purpose.

(4) Although a pile is a copious source of neutrons, it is not a limitless source. It is possible to load a pile for nonfission product radioisotope production only up to the limit at which so many neutrons are absorbed in the introduced material that the chain reaction ceases even though the control rods are withdrawn as far as feasible. With available pile facilities, this limit does not permit the production of a sufficient quantity and quality of many radioisotopes to meet anticipated national demands. To accomplish this it would very likely be necessary to build piles especially designed for the purpose.

(5) Technical problems involved in the irradiation of some materials have been, and will continue to be, responsible for delays in making certain isotopes available by routine irradiation. Examples of such problems are: (a) proper canning of the material to prevent rupture of the container by its internal action or by the external action of the coolant, with consequent loss of the material and damage to the pile; (b) careful purification to prevent loss of neutrons by absorption in impurities as well as undesirable radioactivity in the irradiated material; and (c) proper distribution of the material throughout the pile to prevent local overheating or undesirable regulation characteristics of the pile.

Organization for Allocation and Distribution

In accordance with the established custom of the Manhattan Project of seeking competent outside advice and aid on vital scientific matters, such as nonproject distribution of isotopes, Maj. Gen. L. R. Groves asked the president of the National Academy of Sciences to nominate a representative committee of outstanding scientists to recommend policies and aid in establishing arrangements for a desirable distribution of those tracer and therapeutic isotopes available from Manhattan Project facilities. An interim Advisory Committee on Isotope Distribution Policy was formed, two representatives being chosen from each of the major fields of isotope application: Physics—Lee A. DuBridge (chairman), head, Physics Department, University of Rochester, and president-elect of California Institute of Technology, Pasadena; and Merle A. Tuve, head, Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D. C.; Chemistry—Linus Pauling, director, Gates and Crellin Chemistry Laboratories, California Institute of Technology; and Vincent du Vigneaud, head of the Department of Biochemistry, Cornell University Medical College, New York City; Medicine—Cornelius P. Rhoads, director of Memorial Hospital, New York City, and chairman of the Committee on Growth of the National Research Council; and Cecil J. Watson, head of the Department of Medicine, University of Minnesota Medical School, Minneapolis; Biology—Raymond E. Zirkle, professor of botany and director of the Institute for Biophysics and Radiobiology, University of Chicago, Chicago, Illinois; and A. Baird Hastings, head of the Department of Biological Chemistry, Harvard University Medical School, Cambridge; Applied Science—Zay Jeffries, vice-president and manager of Chemicals Department, General Electric Company, Pittsfield, Massachusetts; and L. F. Curtiss, chief of the Radioactivity Section, National Bureau of Standards, Washington, D. C. Paul C. Aebersold, chief of the Isotopes Branch, Research Division, Manhattan District, was chosen acting secretary to coordinate the efforts of the Committee and to effect liaison with the Project.

The recommendations of this Committee on a suitable interim mechanism for allocation and distribution have been adopted without modification. This mechanism is as follows:

(1) All requests will be submitted to the Isotopes Branch, Research Division, Manhattan District, where each request will be reviewed with regard to all technical questions affecting the requester and the Project. This initial review will be made by a group of scientists in the Project who have had much experience in the production of radioisotopes and in technical matters concerned with their use.

(2) Nonproject requests will then be referred to an Advisory Subcommittee on Allocation and Distribution, which has been appointed by Gen. Groves on the nominations of the Distribution Policy Committee. This Subcommittee will have the responsibility of advising on the allocation and distribution of isotopes according to the scientific value of the intended application and the qualifications of the requester. It will operate under the supervision of the Distribution Policy Committee and in conformity with its approved policies. Its members are: K. T. Bainbridge (physics), Harvard University, chairman; J. W. Kennedy (chemistry), Washington University, St. Louis; J. G. Hamilton (biology and medicine), University of California; P. C. Aebersold (biophysics), Manhattan District, secretary.

(3) Each request for material for use in human beings will be referred by the Subcommittee on Allocation and Distribution to a Subcommittee on Human Application, which was similarly nominated and appointed. This Subcommittee will have final veto power on any distribution suggested for human application. Its members, chosen from among radiologists and clinicians experienced in radioisotope uses, are: Andrew H. Dowdy, University of Rochester, chairman; H. L. Friedell, Western Reserve University; G. Failla, Columbia University.

(4) Small Panels of Consultants, nominated by the Policy Committee from a number of specialized fields of possible isotope application and from various regions of the Nation, will be available as advisers on scientific matters connected with requests.

(5) Manhattan Project personnel have not been excluded from membership in any of the nonproject advisory groups. In many cases their membership has been strongly advocated by the Distribution Policy Committee.

(6) Effective liaison will be maintained between the Isotopes Branch of the Manhattan District Research Division, which initially receives and finally effects distribution on nonproject isotope requests, and the associated advisory groups whose functions are set forth above.

PRINCIPLES OF ALLOCATION AND DISTRIBUTION

In establishing initial policies on the distribution of scarce materials, the criterion used has been the maximum benefit to the national welfare, due consideration being given to the limited amount of available material. The initial policies adopted are:

(1) Isotopes will be made available to individuals only through qualified institutions. The administration of the institution will make the necessary financial and legal arrangements, but the material will be allotted for the uses specified in the request.

(2) Secondary distribution of isotopes will not be sanctioned unless indicated and authorized under the original request or subsequently in writing through the accepted channels for requests.

(3) The initial order of priority adopted for the allocation of materials and of production effort is established according to intended use of the material, as follows: (a) publishable researches in the fundamental sciences, including human tracer applications, requiring relatively small samples; (b) therapeutic, diagnostic, and tracer applications in human beings and publishable researches in the fundamental sciences requiring larger samples; (c) training and education by accredited institutions in the techniques and applications of radioisotopes; and (d) publishable researches in the applied sciences. Allocation of material for researches which are not to be published or for routine commercial applications was considered by the Distribution Policy Committee not to fall within its responsibilities. Allocation for routine commercial

applications will be deferred until experience is gained with supplying the research needs previously mentioned. Special groups may then be established to advise on such allocation.

PRODUCTION AND DISTRIBUTION ARRANGEMENTS WITHIN THE PROJECT

As indicated in the section on availability, none of the separate purified radioisotopes is in routine operational production. In some cases research groups have progressed only to the point of investigating how irradiations can best be performed to create a given isotope and how to isolate the isotope in small amounts. In other cases methods are under investigation in development groups for increasing the scale of irradiation and chemical processing. In a few cases it has now become possible to start placing irradiations and chemical processing into the hands of technical operations groups for routine "production."

Research into methods of small-scale creation of most of the isotopes took place widely before the establishment of the Project; since then, it has been carried on extensively by project laboratories engaged in nuclear research. Thus, credit for the results of research on radioisotopes is shared by many nonproject and project personnel. Most of the research within the Project in this regard has been done by nuclear physics and radiochemistry groups at Clinton Laboratories at Oak Ridge, at the Radiation Laboratory of the University of California, and at the Metallurgical and Argonne Laboratories of the University of Chicago.

The present "experimental-lot production" has been carried on largely by the Clinton Laboratories, which since July 1945 have been administered by the Monsanto Chemical Company. In the case of several isotopes in great demand, the Argonne Laboratory has cooperated in preparing materials in proper form for irradiation at Hanford and in testing the results. The Du Pont Company, operators of the Hanford Plant, has cooperated in making irradiations of materials possible at Hanford. The Monsanto Chemical Company has agreed to initiate the routine production of nationally demanded radioisotopes and to distribute them from the Clinton Laboratories under District Administration.

A Manhattan Project Technical Advisory Committee on Isotopes has been active in maintaining liaison between major laboratories of the Project on (1) production and distribution matters concerned with the national distribution program and (2) developments in radioisotope techniques and applications. This Committee is composed as follows: J. R. Coe, W. E. Cohn, R. McCullough, A. H. Snell, and K. Z. Morgan, of the Clinton Laboratories; W. H. Zinn, W. F. Libby, and R. E. Zirkle, of the Argonne and Metallurgical Laboratories; J. G. Hamilton, B. J. Moyer, and R. E. Connick, of the University of California Radiation Laboratory; J. H. Manley and R. Taschek, of the Los Alamos Scientific Laboratories; and, in regard to concentrated stable isotopes, H. L. Hull and C. E. Larson, of the Tennessee Eastman Corporation, Oak Ridge.

DETAILS OF RADIOISOTOPE AVAILABILITY[1]

Pile-produced Radioisotopes

Radioactive isotopes are created in chain-reacting piles by two processes: (1) the fission of U 235 nuclei, which maintains the chain reaction, and (2) neutron absorption by nonfissionable nuclei placed in the pile for the purpose. The former—the so-called "fission products"—exist as a mixture of many radioactive species, each free of significant amounts of stable (carrier) isotopes, in a large amount of the parent substance, uranium. The desired radioisotope must subsequently be separated from uranium and from the other fission products, as well as from any neptunium and plutonium formed by neutron capture in U 238. In the chemical process actually used, the fission products are separated from the mixture either as individual radioactive species or as groups of species (Col. 1, Table 1).

The Fission Products

The methods now in operation for the preparation of fission-product radioisotopes were developed to meet certain definite specifications, which in turn were set by the biological work in which the radioactive materials were to be used. These specifications called for 0.1–1.0 curie[2] amounts of each of the major fission products in carrier-free, essentially solid-free (< 10 mg./curie) form, and radiochemically pure (> 90–98 per cent, depending on the species); smaller or less pure amounts of minor species were also required. The radiation intensities involved in working with mixtures of fission products at the curie level required the invention and use of chemical processes which were remotely controlled from behind specially constructed lead and concrete barriers and were economical of material. For these reasons the existing processes and equipment are not suited to isolate fission products in forms radically different from those listed. However, since these methods permit the isolation without carrier of nearly every fission product of half-life from 1 week to 30 years and occurring in significant amount, this inflexibility is not considered to be a handicap.

---

[1] Only those radioisotopes of half-life greater than 12 hours are considered.

[2] The curie is here defined as 3.7×10^{10} disintegrations/second. [See statement by Condon and Curtis, p. 712. Ed.]

Those fission-product radioisotopes which can now be isolated[3] from pile uranium in moderate quantity and good quality without added carrier are listed in Tables 1, 2, and 3. In Table 1 are given also the latest data on half-life and radiation energies for each radioelement involved and also the properties of daughter radioisotopes which will be present. The values in the columns headed "*Approximate maximum unit quantity which may be made available*" give *essentially the amount which may be supplied at one time; requests for more than this amount may be temporarily or indefinitely delayed in fulfillment.* The activity stated in this column is related to the figures giving volume and other characteristics of the preparations.

TABLE 1*

FISSION PRODUCTS†

Group	Radioisotope	Half-life	Energies		Radioactive daughters: Isotope	Half-life	Energies		Probable contaminants	Approx. max. unit quantity which may be made available	Carrier added	Solids present (nonvol.)	Solvent	Volume	Class
			β Mev	γ Mev			β Mev	γ Mev		Curies	Mg.	Mg.		Ml.	
I‡	Zr 95	65 d	1.0§ 0.39§	0.73	Cb 95	35 d	0.15	0.75	......	1	0	~ 0	½% – $H_2C_2O_4$	50	A
	Cb 95	35 d	0.15	0.75	None										
II	Y 91	57 d	1.8	....	None				61	1	0	~ 0	HCl	< 25	A
III‡	Ce 141	28 d	0.6	0.22	None				Pr	1	0	~ 0	"	"	A
	Ce 144	275 d	0.35	....	Pr 144	17 m	3.1	....							
IV	Ba 140	12.8 d	1.05 0.4	0.5	La 140	40 h	1.4, 2.2	1.63‖	Sr	1	0	~ 0	"	"	B
V‡	Sr 89	53 d	1.5	....	None				Ba	1	0	~ 0	"	"	A
	Sr 90	25 y	0.6	....	Y 90	65 h	2.2	....							
VI‡	Pr 143	13.8 d	1.0	....	None				Ce, Y	0.1	0	~ 0	"	"	B–C
	Nd 147	11 d	0.17 0.85	0.6	61 147	~ 4 y	0.2	....							
	61 147	~ 4 y	0.2	....	None										
	Eu 156	15.4 d	0.5 2.5	2	None										
	Eu 155	2–3 y	0.2	0.084	None										
VII	Cs 137	33 y	0.5 0.8	0.75	None				......	0.01	0	~ 0			A
VIII‡	Ru 103	42 d	0.2 0.8	0.56					......	0.1 0.1	0	~ 0	"	< 25	A–B
	Ru 106	1 y	< 0.005	....	Rh 106	30 s	3.9	....							
	Te 127	90 d	0.7	0.086											
	Te 129	32 d	1.8	0.1 0.3 0.8											

* Most data in this table are hitherto unpublished M.E.D. work.

† For I 131, see Tables 3 and 6.

‡ Specific composition depends on age.

§ Two per cent 1.0 Mev and 98 per cent 0.39 Mev.

‖ Complex spectrum.

The letters in the column headed "Class" are an attempt to indicate approximate availability and have the following meanings: A: usually on hand (long half-life permits stock-piling); B: often on hand (shorter half-life does not permit stock-piling); C: seldom on hand; produced on experimental basis only; D: not on hand; can be done but with difficulty.

Inasmuch as a routine production system, with attendant control and standards, does not exist, no

---

[3] It must be emphasized that no routine production system yet exists. The radioisotopes being made available at this time are the results of research and development proceedings.

guarantees of radiochemical or chemical purity or other such characteristic of any entry in any table may be made, although every effort will be made to turn out as high a quality of material as possible. Information relating to the known characteristics of any preparation will be furnished.

TABLE 2

FISSION PRODUCTS

(Derived from products in Table 1)

Source (Group in Table 1)	Radio-isotope	Probable radioactive contaminants	Approx. max. unit quantity which may be made available	Carrier added	Solids present (nonvol.)	Solvent	Volume	Class
			Curies		Mg.			
I	Cb 95	Zr	0.05	0		½% = $H_2C_2O_4$	< 25 ml.	C
VIII	Ru 103 Ru 106		0.05	0	~ 0	HCl	"	C
VIII	Te 127 Te 129		0.05	0	~ 0	"	"	C
VI	Pr 143*	Nd, 61	0.02	0	~ 0	"	"	C–D†
VI	Nd 147	Pr, 61	0.02	0	~ 0	"	"	C–D†
VI	61 147	Pr, Nd	10^{-4}	0	~ 0	"	"	C–D†

* See Table 6. † Depends on purity required and age.

Nonfission Radioisotopes

In Tables 4–6 are listed those neutron-induced radioisotopes of half-life greater than 12 hours which are known or believed to be producible in the pile.

(1) *Non-carrier-free radioisotopes; simple (n,γ) reactions* (Table 4). The most prominent reaction is simple neutron absorption, yielding a radioactive element isotopic with the parent element. This is the (n,γ) reaction (Table 4), which differs from transmutation and fission reactions in that carrier-free material *is not* produced (except in those few cases where a radioactive chain is begun).

TABLE 3

FISSION PRODUCTS

(By-products usually on hand in impure form)

Radio-isotope	Quantity usually available	Carrier added	Solids (nonvol.)	Solvent	Volume	Class
	Curies	Mg.	Mg.			
Sr 89 Sr 90 *	1	0	~ 0	N/2 HCl	< 25 ml.	A
I 131†	0.1	0	~ 0	N/10 HNO_3	< 25 ml.	B
Ba 140*	1	> 0	> 0	N/2 HCl	< 25 ml.	B

* See Table 1 for radiation characteristics of isotopes and daughters.

† See Table 6.

To obtain an isotope of this kind involves the insertion of the element, in a suitable form,[4] into the pile and its subsequent removal. Even though in some cases (n,p) radiocontaminants are produced along with the desired *(n,γ)-induced radioisotope,* no chemical separation process on the active material will be done prior to shipping (hence the term "service irradiation" to describe such an activation). In order to utilize the available facilities most efficiently, these materials will be exposed in the same containers in which they will be shipped, and only certain quantities will be irradiated. Therefore, *those radioelements supplied without processing will be available only in units which are 1, 0.1, 0.01, and (sometimes) 0.001 part of the quantities listed under "Approximate maximum unit quantity which may be made available."*

(2) *Carrier-free radioisotopes* (Tables 5 and 6). Transmutation reactions yield radioisotopes which differ chemically from their parents and hence exist *without*[5] stable isotopic "carrier." Only a small number of elements are known to undergo (n,p), (n,α), etc. reactions to any appreciable degree in the pile; however, the few which do yield some of the most important radioelements (Table 5). In addition to these types, in which transmutations are effected, there is a group of (n,γ)-induced decay chains which can be utilized to yield carrier-free material (Table 6). In this case a radioisotope produced by a (n,γ) re-

---

[4] In many cases it is advisable to irradiate elements in the form of a compound. The particular compound selected must be such as to lend itself to irradiation under the expected pile conditions. Undesirable radioactive species and unsatisfactory containers must be avoided. For these and other reasons, the materials to be exposed in the pile for radioisotope production will usually be supplied and packaged by the Project.

[5] Except for impurities below detectable levels.

TABLE 4

LONG-LIVED RADIOACTIVE ISOTOPES PRODUCIBLE IN PILE BY (n,γ) REACTIONS
(Items in italics—Manhattan Project data)

Active isotope	Half-life	Radiation Mev		Approx. specific activity (mc./gram element)*	Approx. max. unit quantity which may be made available*	Class
		β	γ			
Na 24	14.8 h	1.4	1.4, 2.8	250	100 mc.	A
P 32	14.3 d	1.69		72	500 mc.‖	A
S 35†	87.1 d	*0.17*		1.0	1 mc.‖	D
Cl 36†	*10^6 y*	*0.66*		~ 0.002	10 μc.	D
K 42	12.4 h	3.5	?	20	1 c.	D
Ca 41	8.5 d	K	1.1	0.34	10 mc.	D
Ca 45	180 d	*0.3*		3.8	100 mc.‖	C
Sc 46†	85 d	0.26 1.5	1.25	125	1 mc.	C
Ti 51	72 d	0.36	1.0	0.13	1 mc.	D
Cr 51	26.5 d	K	*0.32*	70	100 mc.	C
Fe 55	~ 4 y	K		0.07	100 μc.	C
Fe 59	*44 d*	0.26 0.46	1.1, 1.3	0.15	1 mc.	C
Co 60	5.3 y	0.3	1.1, 1.3	48	100 mc.	B
Ni 59	*15 y*	*0.05* β^+			10 μc.	D
Cu 64	12.8 h	0.58 β^+ 0.66 β^-		440	10 mc.	C
Zn 65	250 d	0.4 β^+ K, e$^-$	1.14	3.6	100 mc.	D
Zn 69	13.8 h	I.T. 1.0	0.439	10	100 mc.	D
Ga 72	14.1 h	*3.4* 0.8	0.84, *2.25*	230	100 mc.	C
Ge 71 †	11 d	*0.6*	0.5	14	100 mc.	D
Ge 77	12 h	1.9		0.9	10 mc.	D
As 76	26.8 h	1.1, 1.7 2.7	0.57, *1.25*	770	100 mc.	C
Se 75	*125 d*	K, e$^-$	*0.18, 0.35*	5.6	100 mc.	D
Br 82	34 h	0.465	0.547, 0.787 1.35	170	100 mc.	C
Rb 86	19.5 d	1.60		52	100 mc.	D
Sr 89	53 d	1.5		0.2	10 mc.¶	D
Y 90	65 h	2.5		150	100 mc.¶	C
Zr 95‡	*65 d*	1.0, 0.39[a]	*0.73*	0.32	¶	D
Mo 99‡	67 h	1.3	0.24, *0.75*	12	100 mc.	D
Ru 103	*42 d*	0.2, *0.8*	0.56	6.4	10 mc.	D
Ag 108, 110	225 d	*1.3*	0.6, 0.9	10	100 mc.**	D
Cd 115 ‡	*2.8 d*	1.11	0.65	33.2	10 mc.	D
Cd 115	*43 d*	1.5		1.6	1 mc.	D
In 114	48 d	I.T., e$^-$ 2.0	0.19	200	100 mc.	C
Sn 113	< 100 d	K, e$^-$	0.085	0.26	1 mc.	D
Sb 122	2.8 d	0.81, 1.64	0.8	400	100 mc.	C
Sb 124	60 d	0.74, 2.45	1.72	83		C
Te 127 ‡	90 d	I.T., e$^-$ *0.7*	0.086	0.3	10 mc.¶	C
Te 129	32 d	I.T., e$^-$ 1.8	0.102 *0.3, 0.8*	0.3		C
Te 131	30 h	I.T. β^-	0.177	0.3		C
Cs 134	2 y	*0.75*	*0.8*	200	1 c.¶ **	C
Ba 131‡	12 d	K, e$^-$	*1.2* (?)	0.44	10 mc.¶	C
La 140	40 h	1.4, 2.2	1.63§	760	100 mc.¶	D

---

[a] Two per cent 1.0 Mev and 98 per cent 0.39 Mev particles.

TABLE 4—(*Continued*)

(Items in italics—Manhattan Project data)

Active isotope	Half-life	Radiation Mev β	Radiation Mev γ	Approx. specific activity (mc./gram element)*	Approx. max. unit quantity which may be made available*	Class
Ce 141 ‡	28 d	0.6	0.22	90	100 mc.¶	C
Ce 143	33 h	*1.36*	*0.5*	22	100 mc.¶	C
Pr 142	19.3 h	2.14	1.9	750	100 mc.**	C
Eu 154	6.5 y	0.9	Present	250	100 mc.	D
Ta 182	97 d	*0.53*	1.22, *1.13*§	300	100 mc.	C
W 185	77 d	0.6	†	10	100 mc.	C
Os 191	32 h	1.5	Present	44	100 mc.	D
Os 193	17 d	0.35	Present	103	100 mc.	D
Ir 192, 194	19 h 70 d	2.2 Present	1.35 0.3, 0.4	~ 250	100 mc.	C
Au 198	2.7 d	0.8	0.12, 0.44	6,000	100 mc.**	C
Hg 197	64 h 25 h	K, e⁻ K, e⁻	0.075 0.13, 0.16	11	100 mc.	D
Hg 203, 205	51.5 d	*0.3*	0.28	16	100 mc.	D
Tl 206	3.5 y	0.87		2	10 mc.	D
Bi 210†	5.0 d	1.17		9	10 mc.	C

* May be raised in special circumstances.
† Radioactive contaminant will be present from (n,p) reaction.
‡ Radioactive (nonisotopic) daughter will be present.
§ Complex.
‖ See Table 5.
¶ See Tables 1–3.
** See Table 6.

action decays to a radioactive daughter which is nonisotopic with its parent and with the source material.

A separation of the desired active species from the stable parent and from any (n,γ)-induced radioisotopes of this parent must usually be made before use. Since the parent exists in bulk and there is often formed a large amount of radioactive material which is isotopic with the parent, the processing is not always a simple matter. The same considerations hold in the case of daughters of neutron-induced decay chains.

Again, because of the desire to make available the greatest number of radioisotopes, *such carrier-free species will usually be supplied in the irradiated material, unseparated from the parent and radioisotopes of the parent.* In these cases, as in all others, any

TABLE 5

RADIOACTIVE ISOTOPES FROM TRANSMUTATION REACTIONS

(Items in italics—Manhattan Project data)

Method of formation	Active isotope	Half-life	Radiation Mev β	Target material	Yield mc./gram element irradiated	Conditions for shipment (C.F. = carrier-free)	Approx. max. unit quantity which may be made available	Class
(n,p)	C 14	~ 25,000 y	0.145	$Ca(NO_3)_2$		$BaCO_3$	1 mc.	A
	P 32	14.3 d	1.69	S	0.5*	In S C.F. in 0.1 *N* HCl	500 mc.†, ‡	B B
	S 35	87.1 d	*0.17*	KCl or other chloride	1.5*	In KCl C.F.	10 mc.†	B D
	Ca 45	180 d	*0.3*	Sc_2O_3	0.57*	In Sc C.F. in conc. HCl	100 μc.†, ‡	C C
(n,α)	H 3	~ 31 y	0.015	Li salt		Unavailable at present		

* Experimental data.
† See Table 4.
‡ May be raised in special circumstances.

pertinent experience in a particular separation will be made available. In a few cases, where the element is rare or where the separation is too hazardous to be accomplished without special facilities, only separated material will be supplied.

The symbols in the "Class" column of Tables 4, 5, and 6 have essentially the same meaning as those in Tables 1, 2, and 3 except for "D," which here indicates a reaction which has been reported but has not yet been checked by present personnel.

PILE IRRADIATION SERVICES FOR OTHER THAN RADIOISOTOPE PRODUCTION

Materials to be exposed in the pile for radioisotope production will usually be supplied and packaged by the Project. The reasons for this are: (1) to insure that materials and containers introduced into the pile for the desired radioisotope production have minimal parasitic neutron absorption and minimal subsequent radioactivity, and (2) to avoid the possibility of loss of the irradiated material or of danger to the operation of the pile.

TABLE 6

RADIOACTIVE ISOTOPES FROM (n,γ)-PRODUCED CHAINS

(Items in italics—Manhattan Project data)

Active daughter isotope	Half-life	Radiation Mev		Target material	Half-life of parent	Yield mc./gram element irradiated	Conditions for shipment	Approx. max. unit quantity which may be made available	Class
		β	γ						
As 77	*40 h*	*0.8*		GeO_2	12.0 h	0.9	In GeO_2	1 mc.†	D
Rh 105	36 h	0.5		RuO_2	4.0 h	7.2	In RuO_2	10 mc.	D
Ag 111	7.5 d	0.8		Pd	26 m	9.7	In Pd	10 mc.	C
I 131	8.0 d	0.6	0.367 0.080	Te	30 h	2.5*	In Te C.F. in 0.5 *N* H_2SO_4	100 mc.	B C
Cs 131	*10.2 d*	*K*		*$BaCO_3$*	*12 d*	~ 0.4*	In $BaCO_3$ C.F. in 0.1 *N* HCl	100 μc.†	B C
Pr 143	13.8 d	1.0		CeO_2	33 h	9.1*	In Ce C.F. in 0.1 *N* HCl	10 mc.†	B C
Au 199	3.3 d	1.01	0.45	Pt	31 m	19.3	In Pt	†	D

* Experimental data. † See Table 4.

Requests for special irradiations, in which the requester desires to furnish the material, may arise because of: (1) other intended purposes than radioisotope production or (2) especially prepared or very rare materials. Such irradiations may require special handling which will be difficult to arrange during the inauguration period of the radioisotope distribution program. When sufficient experience has been gained in handling the normal irradiations and when a scale of charges is determined, special irradiation services may be announced.

AVAILABILITY OF CONCENTRATED STABLE ISOTOPES

In answer to numerous inquiries some brief comments are in order regarding the Project's ability to furnish concentrated stable isotopes. Arrangements have been completed thus far for the production, allocation, and sale of radioisotopes only. It may require considerable time to arrange these matters for such concentrated stable isotopes as may become available in excess of project needs.

The situation in regard to availability is now as follows:

(1) *Deuterium.* There is no heavy water or H 2 available.

(2) *Boron 10.* Small amounts of highly concentrated B 10 may be available for special neutron counter purposes. Prices and distribution mechanism are yet to be determined. These will be announced when arranged.

(3) *Carbon 13.* This isotope is mentioned separately only because of the wide interest in it for tracer purposes, particularly in organic chemistry and biology. There are no project facilities which can at present be converted to concentrate C 13 in production amounts without great expense both in the conversion of equipment and in operation. The cost of C 13 based on operational expenses alone would be considerably higher than costs quoted for C 13 concentrated by chemical exchange methods.

(4) *Isotopes of elements 3 to 82.* Small experimental lots of isotopes of nongaseous elements have been concentrated for project nuclear researches using electromagnetic pilot plant facilities of the Tennessee Eastman Corporation at Oak Ridge.

Studies have only recently begun on production costs and on the obtainable quality and quantity of concentrated materials. In general, production is quite expensive, and it is difficult to achieve the high isotopic purity desired for many nuclear studies. Arrangements may be formulated for nonproject distribution of experimental lots after more experience has been gained with concentration and assay methods and after project needs become more clear.

As the situation warrants, announcements will be made concerning the availability of concentrated stable isotopes.

CHARGES

Charges will be made for irradiated materials and processed isotopes, as is the case for many widely useful products resulting from other research efforts. Pending experience, a reasonable charge is considered to be one based on the "out-of-pocket" operational expenses necessitated by the nonproject production and service program. Charges will not include costs of rental, or construction of plant and major facilities or of research and development directed toward the supplying of isotopes in general. The Project will supply the major facilities and develop the production methods, but will assess a charge for the additional running expenses of man power and materials incurred by the filling of nonproject requests. Shipping expenses will be paid by the requester. Details of these arrangements and the prices to be charged may be obtained upon request from the Isotopes Branch of the Manhattan District Research Division.

MECHANISM FOR MAKING REQUESTS

As explained in the section on "Principles of Allocation and Distribution," radioactive materials will not initially be distributed directly to private individuals but only to accredited institutions or organizations. However, materials will be allocated to an individual or a department for the specific uses proposed in the request.

A request may be initiated by a responsible applicant in an accredited institution by a short letter to the Isotopes Branch, Research Division, Manhattan District, P. O. Box E, Oak Ridge, Tennessee. This letter should request application forms, price quotations, and any essential information not contained in this notice. It should indicate briefly the radioisotopes desired, the approximate quantities needed, and the use to be made of the materials. If the desired material can be produced or made available and the intended use is one for which the isotope is suited, application forms will be furnished the applicant. These forms will permit applicants to supply in a concise and uniform manner the necessary detailed information on the basis of which the reviewers and the nonproject Advisory Subcommittee on Allocation and Distribution will be able to recommend action.

Action on an initial formal application cannot be initiated unless it has been indicated on the application that, when material is allotted, an "Agreement for Order and Receipt of Radioactive Materials" will be negotiated by the business administration of the requesting institution. This agreement relates to business and legal responsibilities in connection with the ordering, receipt, application, and disposal of radioactive materials by the applicant. The honoring of subsequent applications from the same individual or department can be arranged on a continuing basis by the indication of authorization for this in the originally negotiated agreement. All correspondence concerning requests and all forms should be addressed to the Isotopes Branch, as indicated above.

A Nuclear Research Institute at Oak Ridge

The Executive Committee, Oak Ridge Institute of Nuclear Studies

THE INTERNATIONAL SIGNIFICANCE of atomic energy as a military weapon and its potential peacetime uses have been in the forefront of public discussion for some time and have overshadowed other problems relating to the future of atomic energy developments. One problem that is receiving much attention in scientific circles today concerns the best procedure for ensuring the continuance and further development of broad fundamental research in the field of nuclear studies.

While there are differences as to procedure, the consensus appears to be that the broad national interest can best be served through the establishment of research centers for nuclear studies in several parts of the country. Established research groups in universities, government agencies, or industry can then cooperate with these centers in carrying on atomic research in physics, chemistry, biology, medicine, and engineering. It is well recognized that the cost of nuclear research is such that few, if any, of the established private research agencies, working alone, will be in a position to make substantial contributions to this field.

The position of Oak Ridge as a possible location for one of these centers appears to be unique, both because of the elaborate facilities already built and in operation there and because of the presence of a large and active research group in the Clinton Laboratories already effectively engaged in such research. In view of this situation, a group of southeastern universities is sponsoring a plan looking toward the establishment of an Oak Ridge Institute of Nuclear Studies, where research at the Ph.D. level and above would be carried out in the fields of physics, chemistry, biology, medicine, and engineering. The establishment of such an institute will provide the formal channels for cooperative research between the universities and governmental research and producing agencies associated with the atomic energy project at Oak Ridge.

Although the initial sponsorship of this Institute has been confined to southeastern universities, other universities outside the region are now participating in its development. It is contemplated that a number of institutions throughout the United States will share in this cooperation, even though they are looking forward to the establishment of new research centers, similar to Oak Ridge, in the section of the country in which they are located.

The early establishment of such a cooperative Institute at Oak Ridge will have a number of important advantages in terms of the national interest in the development of atomic energy. Among these may be cited the following:

(1) The development of the Institute around the already existing research and production facilities at Oak Ridge can be accomplished with a minimum of delay so that cooperative research with universities can go forward actively at an early date. It will, obviously, be at least one to two years before the necessary organizational plans, design, and construction of facilities can be completed for the establishment of new centers for such cooperative research in other parts of the country.

(2) The cooperative Institute at Oak Ridge will serve as a prototype for the establishment of similar centers in other parts of the country. In the interim before the establishment of such other centers, research workers from universities in various parts of the country can be initiating research programs relating to nuclear studies, which otherwise would have to be delayed from one to three years.

(3) Two large isotope separation plants are being operated at Oak Ridge for the large-scale production of U 235 in addition to the research program being conducted at the Clinton Laboratories. Although these units are primarily industrial, the proximity of the large and active research group at the proposed Institute will be of great value in ensuring the vigorous development of these methods and in attracting and holding competent technical personnel for them.

(4) The location of a nuclear research center in the southeastern region is clearly important to the national interest. The recruiting of potential man power for work in this field has in the past been neglected except in limited regions of the country, notably the Northeast and the far West. With the location of a large and progressive research establishment in the Southeast, young men who otherwise would not be attracted to scientific work of this type will become interested.

(5) It is apparent that such research centers, wherever they are located, will have to be organized as geographically independent entities, and it will not, in general, be possible to locate them in close proximity to already existing educational or governmental institutions. The availability of an adequate amount of Government-owned land and the Government's existing large investment in facilities at Oak Ridge point toward this as one of the logical locations for the establishment of such a research center. In order to implement the establishment of such a cooperative Institute effectively, it will be necessary only to group and allocate properly such expanded research facilities as are contemplated at Oak Ridge in a common area where they can serve as the nucleus for the development of a future Institute. It is hoped that planning for the extension of research facilities at Oak Ridge will be done in such a way that these facilities can be brought together in a common area which would be appropriate for the future development of an Institute.

The national stake in the future of atomic energy is a vital one, and any steps that will assure that active research is not interrupted are of the utmost importance at this time. The effectiveness of such research depends on continued cooperation between private agencies, such as the universities and industry, and the Government. It therefore seems imperative that advantage be taken of the opportunity existing at Oak Ridge, with its established facilities and personnel, to develop immediately such cooperative research through the organization of an Institute for advanced nuclear studies.

MEMBERS OF THE EXECUTIVE COMMITTEE

W. G. Pollard, University of Tennessee, *Chairman*; P. W. McDaniel, Manhattan Engineer District, *Secretary-Treasurer*; J. P. Ferris, Tennessee Valley Authority; P. M. Gross, Duke University; D. E. Hull, Carbide & Carbon Chemicals Corporation; H. L. Hull, Tennessee Eastman Corporation; F. G. Slack, Vanderbilt University; and E. O. Wollan, The Clinton Laboratories, Monsanto Chemical Company.

Technical Papers

Interpretation of Resistance to Fusarium Wilt in Tomato

William C. Snyder, Kenneth F. Baker,
and H. N. Hansen
Division of Plant Pathology
University of California, Berkeley and Los Angeles

It has been established (*6*) that the Pan America tomato is highly, but not completely resistant to the Fusarium wilt disease, caused by *F. oxysporum* f. *lycopersici* Snyder and Hansen, under conditions fatal to the susceptible variety, Bonnie Best. In endeavoring to determine the nature of this resistance Fisher (*2*), and more recently Gottlieb (*3*), and Irving, Fontaine, and Doolittle (*5*) have given evidence that the expressed sap from resistant Pan America plants is inhibitory to the growth of the pathogen *in vitro* when compared to that from susceptible Bonnie Best plants. Heinze and Andrus (*4*) have concluded from their study of reciprocal grafts of these two varieties that "resistance to the wilt fungus in tomatoes appears to be localized entirely in the root systems of the resistant varieties and is not transportable." This implies that the tops of Pan America are susceptible. However, only infection through roots was considered, and no evidence was presented on susceptibility or resistance of tops. Moreover, the work of Irving, *et al.* and Gottlieb indicates that the substance responsible for resistance is found in all parts of the plant.

The writers have approached this question with still a different technique. Our results, added to what has already been done on the subject, seem to justify the following conclusions: First, resistance is not localized in the root system. Second, the substance responsible for the resistance is not present in inhibitory amounts in the xylem stream. Third, resistance originates in the living tissues of the plant, and the material causing resistance does not migrate or diffuse into the xylem vessels. Fourth, field resistance to infection functions in living cells of the roots through which the fungus, a soil organism, must pass to become a vascular pathogen.

Bonnie Best and Pan America plants were grown in sterilized soil and inoculated when six weeks old by cutting through the lower taproot under a spore suspension of the fungus. The roots were washed and the plants repotted singly in six-inch pots in the greenhouse. In every case the fungus spores began growth in the vascular elements of the root into which they had been drawn when the root was cut, and the mycelium developed upward through the root into the above-ground stem, producing therein vascular discoloration. The discoloration extended higher in the stems of Bonnie Best than in those of Pan America. Foliage symptoms appeared on Bonnie Best rapidly under these conditions, but only a few individuals of Pan America showed disease symptoms. The failure of symptoms to appear in all Pan America plants containing the fungus in the xylem of the stem indicates the presence of resistance in the stem as well as the roots.

The presence of the fungus in the xylem was demonstrated by cultures, and by microscopic examination of stained sections it was shown to have developed in the vascular elements of Pan America about as robustly and abundantly per infected element as in Bonnie Best. Therefore, if there were any fungus inhibitor present in the tracheal fluid of the Pan America plants, it must have been negligible in its effect. The number of vessels infected in Pan America was much lower than in Bonnie Best (perhaps owing to the inoculation method), and this fact may explain in part why the former shows symptoms slowly, if at all, even though the fungus be present in root and above-ground stem. An explanation for this phenomenon may lie in multiple infection of the xylem elements of Bonnie Best following surface contamination of lateral roots during inoculation, whereas infection of Pan America by this technique allows invasion only of those elements into which the spores actually were drawn. If this interpretation is correct, the wilt symptoms obtained in Bonnie Best, but not in invaded Pan America plants, are an expression of fungus mass action in toxin formation.

The comparable robust growth of the fungus *in vivo* in the infected vascular elements of both varieties of plants also argues against a mobile fungus inhibitor in one of them. In the resistant plant, growth of the fungus in the xylem shows that resistance is not a property of the entire root system.

Additional evidence that an inhibitory substance is lacking in xylem fluid was shown by the comparable growth of the fungus *in vitro* in such liquid obtained from resistant as well as susceptible plants. The fluid forced by root pressure from the cut ends of plants truncated at the soil level was used for this test. It appears, therefore, that xylem fluid is noninhibitory to the fungus *in vivo* and *in vitro*. This would indicate the absence or high dilution of the resistant factor therein.

If disease resistance in Pan America is physiological in nature, conceivably it may consist of resistance to invasion, resistance to yellowing and wilting, or to both. The former, which is under consideration in this paper, is concerned with the entrance of the fungus into the xylem; the latter, with production of toxins in the tissue.

If it is true that under natural conditions favorable for the disease *F. oxysporum* f. *lycopersici* enters the susceptible plant through the undifferentiated tissue just back of the root tip and that the resistant plant does not become invaded, at least not to the extent that vascular elements are entered, the above observations would indicate that resistance is a quality of the living cells only of the Pan America plant. It is this quality which appears to bar the fungus from the lumen of the xylem tubes.

It may be concluded from all evidence so far presented that resistance here in the Pan America tomato to invasion by the wilt Fusarium is a direct function of the cellular protoplasm of the plant similar to that of cabbage (*1, 7*). Apparently it is present but not localized in the root system, and does not operate in the xylem.

References

1. ANDERSON, M. E., and WALKER, J. C. *J. agric. Res.*, 1935, **50**, 823–836.
2. FISHER, P. L. *Md. agric. exp. Sta. Bull. 374*, 1935.
3. GOTTLIEB, D. *Phytopathology*, 1943, **33**, 1111.
4. HEINZE, P. H., and ANDRUS, C. F. *Amer. J. Bot.*, 1945, **32**, 62–66.
5. IRVING, G. W., JR., FONTAINE, T. D., and DOOLITTLE, S. P. *Science*, 1945, **102**, 9–11.
6. PORTE, W. S., and WELLMAN, F. L. *U. S. Dept. Agric. Circ. 584*, 1941.
7. SMITH, ROSE, and WALKER, J. C. *J. agric. Res.*, 1930, **41**, 17–35.

The Blood Parasites of the Blue Grouse

C. DAVID FOWLE

Department of Zoology, University of Toronto

In a recent paper Herman (*1*) listed the avian blood protozoa of North America and indicated the hosts in which they had been found. In view of the fact that the blue grouse (*Dendragapus obscurus*) is not included in his host list it would seem to be of value to record a few observations made recently upon the blood of this species.

Blood samples were collected during the summers of 1943 and 1944 from 44 specimens of blue grouse (Subspecies: *Dendragapus o. fuliginosus*) taken on Vancouver Island, British Columbia. In 1943 smears were made from 28 birds taken at Campbell River during June, July, and August. Four more were made in August of the following year. One smear was made from a bird collected at Cowichan Lake in 1943 and from 11 additional specimens collected from the same vicinity during September 1944.

Four blood parasites, namely, *Trypanosoma, Haemoproteus, Leucocytozoon,* and *Microfilaria,* were observed in smears after they had been stained in Giemsa. The incidence of infection with these parasites is shown in Table 1.

The incidence of infection was higher in Campbell River birds examined in 1943 (see Table 2) than in the combined sample from Campbell River and Cowichan Lake (see Table 1).

TABLE 1

INCIDENCE OF PARASITES IN PER CENT
(CAMPBELL RIVER AND COWICHAN LAKE, 1943 AND 1944)

No. of birds	44 Whole sample	23 Adults	21 Juveniles
Trypanosoma	5	4	5
Haemoproteus	52	57	48
Leucocytozoon	18	22	14
Microfilaria	12	22	..
Negative	41	43	38

In Table 2 it will be noted that while the incidence of infection among juveniles approximates that shown in Table 1 the figures for adults are considerably higher. Unfortunately, no comparison can be made between the two collecting stations because there is insufficient material from Cowichan Lake for 1943.

TABLE 2

INCIDENCE OF PARASITES IN PER CENT
(CAMPBELL RIVER ONLY, JUNE, JULY, AUGUST, 1943)

No. of birds	28 Whole sample	12 Adults	16 Juveniles
Trypanosoma	7	10	6
Haemoproteus	64	83	50
Leucocytozoon	29	42	19
Microfilaria	15	40	..
Negative	25	17	31

The degree of infection observed for these four parasites varied, but in no case were they very great. Trypanosomes were found in extremely small numbers in only two birds. *Leucocytozoon* seldom exceeded two parasites per thousand blood cells. In the case of *Haemoproteus,* the commonest and most numerous form noted, the infection in adults at Campbell River averaged 12 parasites per thousand cells during the months of June, July, and August. Infections ranging from 1 to 27 organisms per thousand erythrocytes were noted. The figures for juvenile birds collected during the same period were, on the average, somewhat lower. All birds collected at Cowichan Lake during September 1944 showed light infections ranging around two to three organisms per thousand cells. Moreover, 7 out of 10 smears collected at this time were negative. This may indicate that the degree of infection decreases at the end of the summer. A definite statement cannot be made, however, since the degree of infection during September 1944 at Campbell River is not known and no comparison can be made.

Microfilariae were found in the blood of 22 per cent of the adults but were not observed in any of the juveniles. In no case were they very numerous. This does not mean, however, that the young birds were not infected. It is possible that the adult parasites were present but had not reached maturity in the solid tissues. Consequently, the young stages would not have appeared in the blood.

Mixed infections were found in 7 birds as follows:

		Per cent
Haemoproteus, Leucocytozoon, Trypanosoma	1 bird	2
Haemoproteus, Leucocytozoon, Microfilaria	3 birds	7
Haemoproteus, Trypanosoma	1 bird	2
Haemoproteus, Microfilaria	2 birds	4.5

Few data as to the mode of transmission of these parasites were obtained. Louse-flies (*Diptera, Hippoboscidae*) of unknown species were noted on 4 out of 53 birds (7.5 per cent) collected at Campbell River in 1943. However, no adequate study was made to prove that these were the transmitting agents. In any case, they do not appear to be numerous enough to account for the high percentage of infected birds in the population.

None of the birds examined appeared to be suffering any ill effects from infections by any of these parasites.

(I am indebted to Dr. A. M. Fallis, of the Ontario Research Foundation, for assistance in the preparation of this note.)

Reference

1. Herman, C. M. *Bird-banding*, 1944, 15, 3, 89-112.

The Relative Effectiveness of Pure Penicillins G, X, and K

Robert D. Coghill, A. E. Osterberg, and G. R. Hazel
Abbott Laboratories, North Chicago, Illinois

In connection with the study of a new penicillin prepared in this laboratory it was noted that the blood levels resulting from its injection were of a shorter duration than those obtained under the same conditions from a commercial penicillin. Because this new penicillin (No. 128) had an activity of 3,500 units/mg. as compared with 2,300, 1,667, and 900 units/mg. for penicillins K, G, and X, respectively, consideration was given to the possibility that it was being excreted faster than the others. This might follow when one considers that it takes approximately four times as many molecules of penicillin X as it does of the new penicillin to give dosages which are equivalent in terms of International Units.

Accordingly, an experiment was set up to determine whether the rate of excretion of a pure penicillin is a function of its potency in terms of units/mg., or, in other words, of the number of molecules injected. The penicillins used were analytically pure preparations of the crystalline compounds. These had been subjected previously to extensive chromatographic treatment to insure their separation from other penicillins. They were dissolved in normal saline at a concentration of 5,000 units/ml.

Each penicillin, on different days, was injected into each of the same four subjects. Twenty-five thousand units were injected intravenously into one arm, and blood samples withdrawn from the other arm at suitable intervals. Urinary excretion of the penicillins was measured at half-hourly intervals during the first two hours and hourly thereafter. The urine was assayed[1] by the usual cylinder[2]-plate method against *Staphylococcus aureus* 209P, and the blood levels were determined by the method of Heilman (*1*) against her strain of a hemolytic streptococcus. A penicillin G standard was used in each case.

The duration of penicillin blood levels of at least 0.03 unit/ml. for each of the penicillins was as follows: penicillin G, 2–2.5 hours; penicillin 128, 1–1.25 hours; penicillin K, .5–.75 hour; and penicillin X, 4–4.5 hours. Even though the figure for penicillin X is somewhat exaggerated because the test organism is approximately eight times as sensitive to this penicillin as it is to the standard penicillin G,[3] the blood levels do not fall in the same order as the activities as expressed in units/mg.

The explanation for the poor action of penicillin K is apparent when one examines the excretion figures. These indicate that during the first two hours, the various penicillins are excreted in the following percentages: penicillin G, 83; penicillin 128, 58; penicillin K, 28; and penicillin X, 78. Penicillins G and X were excreted in the amount of approximately 80 per cent, the difference between them being within experimental error. Penicillin K, however, was excreted to the extent of only about 30 per cent. Since very little penicillin is excreted after the second hour, this can only mean that penicillin K is very rapidly destroyed in the body—so rapidly that its therapeutic effectiveness must be very small indeed. These excretion figures also indicate the incorrectness of the original premise which formed the basis of the experiments. It would appear that, in the dosage used, penicillins G and X are excreted at about the same rate, even though twice as many molecules of X were used, and that the rate of excretion of penicillin K is obscured by its high rate of inactivation. At the very low concentrations in which penicillin occurs in the blood it is apparently almost completely removed in one passage through the kidneys.

---

[1] The authors are indebted to H. W. Cromwell and his staff for all assays reported in this paper, and to F. H. Stodola, of the Northern Regional Research Laboratory, for his gift of the necessary penicillin X.

[2] Paper discs were used rather than cylinders.

[3] This was determined for each of the penicillins on the original solutions containing 5,000 units/ml. Penicillin X prevented hemolysis at eight times the dilution, and penicillins K and 128 at the same dilution, as did penicillin G.

A check experiment was made with a recent commercial lot of penicillin. Chromatographic examination and corollary checks (including crystallization of its penicillin G) showed this lot to contain approximately 92 per cent of G and 8 per cent of K. Examination of the blood levels and excretion data indicates that this commercial penicillin behaved in every way as did the pure penicillin G—that is, within experimental error.

CONCLUSIONS

On the basis of this admittedly preliminary and meager experimental evidence, one would be justified in concluding that (1) penicillin K is so unstable in the human that its therapeutic usefulness when used parenterally is open to very serious question; (2) penicillins G and X are sufficiently stable that their excretion by the kidney represents the limiting factor in the maintenance of therapeutic blood levels; and (3) penicillin X is sufficiently more active (on an International Unit basis) against at least one strain of a hemolytic streptococcus that its use would be indicated for an infection caused by any organism of similar sensitivity.

Reference

1. HEILMAN, D. H., and HERRELL, W. E. *Amer. J. chem. Path.*, 1945, 15, 7-9.

News and Notes

George Briggs Collins, professor of physics at the University of Notre Dame, has been appointed head of the Department of Physics at the University of Rochester. Dr. Collins, who will begin his new duties with the fall semester in September 1946, succeeds Lee A. DuBridge, head of the Rochester Physics Department for the last 12 years, who has resigned to become president of California Institute of Technology. Dr. DuBridge, as director of the Radiation Laboratory, was closely associated with Dr. Collins at M.I.T. during the war.

Paul Willard Merrill, of the staff of the Mt. Wilson Observatory, was awarded the Henry Draper medal by the National Academy of Sciences on 23 April for his numerous important contributions, particularly those on stellar spectroscopy.

David Glick has been appointed associate professor of physiological chemistry at the University of Minnesota and consultant in biochemistry to the Veterans' Hospital, Minneapolis. His appointment was effective 1 April 1946.

Frank B. Jewett, president, National Academy of Sciences, delivered a lecture on 10 May before the Sigma Xi Chapter of North Carolina State College. Dr. Jewett spoke on "The Future of Scientific Research in the Postwar World."

Kazimierz Sembrat, Instytut Zoologiczny Uniwersytetu, Wroclaw, Poland, lost all of his academic literature during the war and suffered severe physical injuries from bombings. He is greatly in need of reprints and textbooks in zoology, particularly in the field of experimental embryology. Dr. Sembrat was a Rockefeller fellow at the University of Chicago, Yale University, and the Marine Biological Laboratory at Woods Hole during 1936-37.

Ernest H. Volwiler, executive vice-president of Abbott Laboratories, was granted a D.Sc. degree at Miami University, Ohio, on 2 June. Dr. Volwiler has been a member of the board of directors of Abbott Laboratories, Chicago, and director of research since 1930. He was elected vice-president in charge of research and development in 1933, and became executive vice-president of the Laboratories last March.

John R. Ball, professor of geology and paleontology at Northwestern University and for 30 years a member of the staff, will retire at the end of the current academic year but expects to continue active geologic work.

Alpheus W. Smith, physicist and retiring dean of Ohio State University Graduate School, was awarded an LL.D. at the Ohio State commencement exercises on 7 June.

William C. Krumbein, Gulf Research and Development Company, has accepted an appointment as professor of geology at Northwestern University, effective in September. Dr. Krumbein will participate in development of geological work in the Northwestern Technological Institute, as well as in the teaching program.

Announcements

A Defense Research Laboratory for study in the fields of aeronautics, electronics, chemistry, optics, thermodynamics, acoustics, and mathematics has recently been established at the University of Texas. This organization is one of a series in universities and in industry operating under a Section-T contract with the Bureau of Ordnance. The research goal of the Laboratory, sought through the above fields of study, consists of fundamental problems relating to certain forms of guided missiles.

Dr. C. P. Boner, professor of physics at the University, has been on leave of absence as associate director of the Underwater Sound Laboratory of Harvard University, is the director of the Defense Research Laboratory. Dr. M. J. Thompson, until recently group supervisor for aeronautics at the Applied Physics Laboratory of The Johns Hopkins University, is associate director. The research staff includes members of the University academic staff from the College of Engineering and the Departments of Physics, Chemistry, and Mathematics. This group is augmented by additional full-time research staff members who are being recruited from other laboratories engaged in similar research. The staff numbers approximately 75 people, among them R. C. Anderson, M. L. Begeman, C. P. Boner, H. J. Ettlinger, B. E. Short, M. J. Thompson, and R. B. Watson, all members of the AAAS.

The Michigan College of Mining and Technology announces that the following have returned to its faculty: Chester Russell, associate professor of electrical engineering, from industry; J. H. Service and H. W. Risteen, associate professors of physics and mechanical engineering, respectively, both from the Navy; M. W. Bredekamp, assistant professor of chemical engineering, from the Oak Ridge project; V. W. Johnson, forestry; and Ernest Kemp, geology. Instructors added to the staff are: Clarence Bjork, George Brooks, Lester Dawson, and Harry Winter, mathematics; C. M. Harry, mining engineering; and Thomas Coon, mechanical drawing.

The Lasker Award, presented annually for outstanding service in the field of mental hygiene, will be given this year for the most significant experimental investigation into behavior deviation, it was announced recently by George S. Stevenson, medical director of the National Committee for Mental Hygiene.

Nominations with supporting data, which will be presented to an anonymous jury chosen for its competence to judge accomplishment in the field selected, are now being accepted by the Committee. The work of the candidate must either have been accomplished or have been tested and won general acceptance approximately within the past year. Presentation of the $1,000 award is made each fall at the annual meeting of the Committee, which will be held this year on 30–31 October at the Hotel Pennsylvania. The Lasker Award was established in 1944 by the Albert and Mary Lasker Foundation. Col. William C. Menninger won the award in 1944, and John Rawlings Rees, consultant in psychiatry to the Directorate of Psychiatry of the British Army; and Maj. Gen. G. Brock Chisholm, Deputy Minister of National Health, Federal Department of National Health and Welfare, Canada, received the award jointly in 1945 for outstanding service in rehabilitation.

Plans for construction of a sulfuric acid plant on the James River between Bellwood Road and Kingsland Creek in Bellwood, nine miles southwest of Richmond, Virginia, have been approved by E. I. du Pont de Nemours and Company. The plant, which will be operated by the Grasselli Chemicals Department, will cost approximately $1,500,000. It will be located on a 425-acre site recently purchased by Du Pont and will produce sulfuric acid for local consumers who previously relied on supplies shipped into the area.

Harvard University announces that Gordon M. Fair has been appointed dean of the Graduate School of Engineering, effective 1 July.

Meetings

The Pacific Division of the AAAS will hold its 27th annual meeting at the University of Nevada, Reno, 17–22 June. The following program has been scheduled:

Tuesday morning—A symposium on "Antibiosis," with Thomas L. Jacobs, University of California at Los Angeles; David Bonner and Lowell A. Rantz, Stanford University; and K. S. Pilcher, Cutter Laboratories, Berkeley, California, participating; *Tuesday afternoon,* 4:00–6:00 P. M.—A general reception on the University campus for members of the Association and associated societies and their guests, given by the president of the University, John O. Moseley, and Mrs. Moseley; *Tuesday evening*—A lecture on

"Research in the Social Sciences," by Holbrook Working, Stanford University; *Wednesday evening*—The presidential address on "The Influence of Molecular Structure on Biological Activity," by Linus Pauling, president of the Pacific Division; and *Thursday evening*—A lecture on "Fundamental Particles and Atomic Energy," by Wendell M. Latimer, University of California.

A conference on algebra will be held at the University of Chicago during the week of 15–19 July. Some of the sessions will emphasize the recent contacts of algebra with other branches of mathematics such as topology, function theory, and geometry. It is hoped that the meetings will be held in Eckhart Hall. Reservations should be made directly with Chicago hotels. Hotels in the vicinity of the University of Chicago are the Broadview, 5540 South Hyde Park Boulevard; Del Prado, 5307 South Hyde Park Boulevard; Shoreland, 5454 South Shore Drive; Windermere, 1642 East 56th Street; Mira-Mar, 6218 South Woodlawn. Because of the acute shortage of hotel space, reservations should be made as soon as possible.

New Units for the Measurement of Radioactivity

It has become the custom to express the strength of radioactive sources in terms of curies. This is an erroneous use of this unit, since by original definition the curie is that "amount of radon in equilibrium with one gram of radium" (Rutherford's *Radioactive substances and their radioactivity*, 1913, p. 479; The radioactive constants as of 1930. *Rev. mod. Phys.*, 1931, **3**, 427), as defined by the Radiology Congress in Brussels in 1910. Therefore, the curie can be used only to represent a rate of disintegration in the radium family. It then represents the disintegration rate of radium or its products in equilibrium. Such a use has been endorsed by the International Radium Commission.

The quantity to be specified in designating the strength of radioactive sources in general is the disintegration rate, determined by the decay constant and the number of atoms of the radioactive isotope in the source. This is simply a number, and therefore, to establish a suitable unit, the only requirement is to select a convenient number of disintegrations per second and give it a name. In selecting this number consideration should be given to insure that it can be readily expressed in submultiples, and multiples by the usual prefixes, kilo-, milli-, micro-, etc. A number which fits this requirement is 10^6. Since the curie was named in the honor of M. and Mme. Curie, the co-discovers of radium, it is natural to select the name "rutherford" for the new unit. The appropriate abbreviation is "rd," which conflicts with the abbreviation of no other well-accepted physical unit. The micro-rutherford would become one disintegration per second—a convenient number to remember. Furthermore, the rutherford itself is a small unit of the order of magnitude of many sources used in laboratory measurements. It is sufficiently different in size from the curie that no confusion can arise with the curie in connection with measurements of activities in the radium family. Large sources would require the use of positive powers of 10, which would be preferable to the use of a large unit requiring negative powers of 10.

It should be pointed out not only that continued use of the curie for all radioisotopes requires a redefinition of the curie, but also that the value of the curie is uncertain to at least 4 per cent and values in current use are well outside this limit. The rutherford provides a definite unit. In addition to eliminating the undesirable use of the curie, the proposed unit also eliminates the basic necessity for measuring radioisotopes in terms of a standard. Any measuring device which will determine the total number of disintegrations per second will provide directly the strength of the source in rutherfords. A counting arrangement for which the solid angle factor is known is an example. Radioactive standards may be used to determine this factor for a given geometrical arrangement, but other methods are also available.

In the measurement of sources of gamma rays the roentgen has gained increasing use, largely because this unit is independent of the quality (electron volts) of the gamma radiation. There is need for a unit in which the intensity of gamma ray sources can be expressed to eliminate the use of the curie for this purpose. An obvious unit derived from the definition of the roentgen is a roentgen-per-hour at one meter. The roentgen-per-hour at one meter can be abbreviated to r.h.m., which again is not readily confused with any other common abbreviation. It has been suggested that this abbreviation can be pronounced "rum." It should be noted that a gamma ray source equal to one r.h.m. will have a gamma ray strength 1.18 times that of one curie of radium. Therefore, the roentgen-per-hour at one meter has the same order of magnitude as the curie in the measurement of gamma ray sources.

The National Bureau of Standards, at the suggestion of the Committee on Radioactivity of the National Research Council, recommends the general use of these units.—*E. U. Condon* and *L. F. Curtiss* (National Bureau of Standards).

Letters to the Editor

Concerning Rains of Fishes

At the risk of seeming a very obdurate Sadducee I am afraid that I must persist in my incredulity concerning rains of fishes (*Science*, 1946, 103, 693). That many people have professed to believe in rains of fishes I am well aware. That many people have observed fish on the ground after a heavy rain may be. But no trained observer has yet seen quantities of fish coming down out of the sky.

Dr. Gudger says that these remarkable downfalls have been ''scientifically attested.'' But what does he mean by this? He refers to ''scientific men of high standing and veracity'' who ''did not witness the falls'' yet professed to believe in them. But profession of belief does not in itself constitute evidence, however honored the professor. *No* man's ''printed word'' is ''accepted today by scientific men'' as conclusive proof of anything. It is the very essence of science that it should not be.

Dr. Gudger's evidence is all hearsay, and that often at second and third hand. His fullest account is James Prinsep's account of a Mr. Cameron's communication of the alleged depositions of some Indian farmers. Two of these witnesses state that some of the fish were ''stinking and headless,'' and the one who gave the fullest account said that after the fish had struck him on the head he ''looked at heaven'' and ''saw like a flock of birds flying up.'' The correspondent from Louisiana only states in effect that some fish had been found in boats that had been swamped in a high wind. What more likely?

The very nature of waterspouts, unfortunately, renders exact observation of them almost impossible, and hence little is really known about them. But such accounts as there are (as, for example, in Wenstrom's *Weather.* Boston: Houghton-Mifflin, 1942. Pp. 323–328) suggest that the cone is composed of spray or mist *drawn down from the cloud* and that such water as is drawn up from the surface of the ocean or lake or river by the vacuum—the only part that might possibly carry fish—would not be carried far across the land and could not possibly be mistaken for rain. Milman, in his *Meteorology* (New York: Macmillan, 1929. P. 342), says that ''stories of large quantities of water being carried up from the sea into the clouds is pure myth.''

Bergen Evans

Northwestern University

Why Is Taxonomy Ill-supported?

Fosberg and Diehl, in ''Present status of foreign herbaria and museums'' (*Science*, 1946, 103, 282), make several observations which are important to biological science and with which most botanists will heartily agree. I wish to comment on only one phase of the problem, mentioned by them in these words: ''Systematic botany has traditionally been ill-supported.'' This is true, and it will continue to be true, and deservedly so, as long as taxonomists maintain present principles and practices. Taxonomy is the only branch of science where this is true.

Rewards are bestowed, in taxonomy, for creating names and not for knowledge of the organism named. Some persons have renamed scores, hundreds, and probably even thousands of plants which they never saw and could not possibly recognize if they did see them, but the names so applied must be acknowledged under taxonomic rules, either as valid or as synonyms. No stigma or penalty whatsoever is attached to the creation of innumerable synonyms.

Permanent rights are accorded to the creator of a name, without regard for the general welfare of scientists. This is true whether the name be valid or one of the many kinds of synonyms; whether it was based on knowledge or ignorance; whether it represented an addition to, or merely confusion of, the existing knowledge; and wholly without regard to the inconvenience caused to tens of thousands of other workers. When a man wishes to patent an idea, under United States law, he must submit it to a jury of experts (U. S. Patent Office). If they determine that it is sufficiently new and different to warrant recognition (patent), he has to pay a sum of money to obtain such recognition. After all that, he gets exclusive rights for only 17 years—not forever.

Taxonomy has no required standards of preparation or fitness, yet its products may help or harm many. Anyone who wishes may name organisms, and the names must be recognized forever, either as valid or as synonyms. Schoolteachers must be trained and must pass examinations in order to teach even the three R's in the rural schools. Auto drivers, electricians, plumbers, and public accountants must be examined by experts and must obtain a license before they may operate. Dentists, doctors, lawyers, and ministers must be examined and certified before they can ply their trades. But anyone may apply Latin names to organisms, and the names automatically have permanent status in one or the other of two categories. The products of an ignorant, careless, or dishonest tyro may cause untold and continuing labor to many others much more able.

Taxonomy is the only science that openly appeals to, and openly rewards, the innate selfishness of man by guaranteeing the permanent association of his name with the organism-name he coined, whether it be of value or not. Chemists, physicists, geologists, mathematicians, physicians, and philosophers make discoveries and develop theories of immense importance to humanity, but we are under no compulsion to attach their names when referring to such discoveries and theories. Sometimes we do, in the case of a dozen out of tens of thousands (Boyle, Darwin, Einstein, LaPlace, Newton), but no rule compels it. What is the value of a single plant name, out of a million or more, as compared with one of these great products of the human mind?

These principles and practices of taxonomy have created another field of labor, *synonymy*, fully as difficult, more far-reaching, and even more expensive, as taxonomy, and we are but at the beginning. Some now devote their time to the study of names and never learn about plants. All real taxonomists are compelled to spend an increasing percentage of their time in the study of names, leaving less and less of their energy for the study of plants. Which are the most important to humanity, names or plants? Which are the most important to science?

All of this has been done under a fetish known as stabilizing nomenclature. Fosberg and Diehl refer to systematic botany's contribution in studies to "stabilize nomenclature." I will defy any person to compare the successive manuals of botany issued in the last 100 years and produce any indication whatsoever that nomenclature is being stabilized. If the permanence of patent (priority) rights to a name never had been acknowledged in taxonomy, we would have had a stable nomenclature long since. As it is, all workers in botany have to learn a new set of names for most plants every 25 or 30 years. This not only is maddening, but absolutely unnecessary.

Suppose that we applied such a rule in the realms of chemistry, economics, geology, cosmogony, mathematics, philosophy, physiology, theology, etc., and had to cite the name of the original promulgator of an idea every time we mentioned it. Suppose that we always were finding (as we are) that someone just a little earlier had evolved what might be claimed to be the same idea. Suppose that we had to append the name of the architect or builder every time we mentioned a great structure or addressed a letter to a given house or office building. If we did, we would be approaching the futility of the situation to which the stupidity and unrealism of taxonomists have brought that science.

If the taxonomic world really believed in, or desired, stability of nomenclature, they would have worked to achieve it long ago through limiting prior rights to a specified term of years or through conserving well-known and widely used specific names when they had been in such use for 100, 50, or 25 years. This would prevent the present disastrous absurdity of letting a few-months priority displace names well-known and widely used for 140 years.

CARLETON R. BALL
U. S. Department of Agriculture, Washington, D. C.

Cancer Research and Benefit to Patients

It cannot be otherwise but that the tenacity with which the practitioners of applied or practical research claim omnipotence is matched by the pertinacity with which the practitioners of academic or pastime research claim holiness. While the former clothe their activity with the semantics of utility, their basic motive is, of course, the acquisition of material things. And while the latter clothe their activity with the semantics of increasing knowledge, their basic motives are, of course, self-amusement and fame. Such camouflage is necessary, we humans being what we are. But the conflict between the motives of the two groups is in considerable part responsible for what Prof. George Shull so aptly calls "the historical phenomenon" of the "long interval which" elapses "between the making of a fundamental discovery and the general understanding of its importance and full realization of its benefits" (*Science*, 1946, 103, 547).

Nowhere today is this delay more unhappily evident than in the field of cancer research. The accumulated data of Rous, Shope, Coley, Bittner, Strong, Andervont, Green, Greene, Williams, Taylor, Furth, Twombly, Cowdry, Diller, Bawden, Pirie, Stanley, Wycoff, Kunitz, and others indicate beyond peradventure the path for getting at something of practical benefit to the cancer patient of the future other than surgery and radium.

The demonstration that mother's milk may contain a transmissible agent productive of malignant growth—call it a virus or what you will—is evidence enough of an autogenously produced chemical compound type which is responsible for that distortion of ordered cell growth which results in malignancy and death of the individual. Yet where is the proposal that mothers with family histories of cancer should be warned against breast-feeding their infants? One such I have seen, but this was so buried in the literature that its excavation is impossible.

And where is the proposal that workers acquainted with this principle of transmissible agent should get together as a team, pool their respective experiences, knowledges, and ideas to undertake a concerted, coordinated, cooperative, organized attempt at isolation, identification, and investigation of the offending chemical compound—not separate and alone as they are now doing, but under one roof, in daily contact with each other, exchanging results, information, and ideas to the sole end of bringing as early as possible something of practical benefit to the cancer patient?

It is said that the academic scientists are too egoistic to work together, too set in their opinions, too unwilling to consider alternatives, too determined on fame. If this is so, they should take a leaf from their confreres in industrial research. Here, too, there are able scientists, working together in both applied and fundamental research to bring about results of practical utility. And our best brains in physics worked together in organized cooperation to produce the greatest destructive agent known to man. So why can't the same be done constructively to produce deflation of the second greatest scourge of human living, namely, cancer? Surely logic, reason, common sense, and the call of humanity make such procedure much to be desired.

FREDERICK S. HAMMETT
*The Lankenau Hospital Research Institute
North Truro, Cape Cod, Massachusetts*

Book Reviews

Marine microbiology: a monograph on hydrobacteriology. **Claude E. ZoBell. Waltham, Mass.: Chronica Botanica; New York: G. E. Stechert, 1946. Pp. xv + 240. $5.00.**

It is an extremely difficult business to organize the large number of scattered studies on the microorganisms and microbiological processes of the sea. Work has been done by many people whose interests have varied widely, and papers in all languages have been published in uncommon journals. Many of the questions raised have not been satisfactorily answered. In addition, researches in this field seem to develop from the general to the extravagantly minute in an explosive fashion. A very persistent, almost evangelical temperament is necessary to find, sort, and squeeze all of these into a comprehensible system. It does not come easily.

Dr. ZoBell is one of the few scientists in the country who, by experience and interests, can be regarded as capable of such a project. He has diligently catalogued his sources and edited them to the bone. Specialized reviews of the field have been published at intervals, but *Marine microbiology* is the first attempt since Benecke's digest of 1933 to bring together the whole literature. The work is complete, and inasmuch as little research has been published during the past five years, it is virtually an official introduction to new work.

It is not possible to treat such a large group of sources critically, and some may feel that Dr. ZoBell is overzealous to establish the place of bacteria and other microorganisms in the economy of the sea. Oceanographers, marine ecologists, geologists, chemists, and applied biologists have been concerned for a long time with the degree to which microorganisms determine the composition of waters and sediments, and with their significance in the organic food cycles of local areas. The relatively recent concentrated microbiological programs under Dr. ZoBell at the Scripps Institute of Oceanography and under Dr. Waksman at the Woods Hole Oceanographic Institution have described the qualitative boundaries of the functions of marine bacteria. It is much more difficult to represent the processes in a quantitative fashion, and reading *Marine microbiology* emphasizes the need for studies in this direction if the value of investigations in the field as an integrating science are to be realized.

The book has been organized about the predominant research tendencies. There are chapters on the numbers, types, and distribution of organisms; the influence of physical and chemical environment; bacterial transformations of organic matter; assimilation and regeneration of inorganic nutrients; parasitic, commensural, and antibiotic relations; and sanitary and other practical applications. There are also sections on the microbiology of marine air, and inland salt and fresh-water lakes. Full bibliographic references are given, and there are subject and author indexes, so that the book is an invaluable source finder.

Charles E. Renn

Woods Hole Oceanographic Institution

1946

GERMAN FOR THE SCIENTIST
By Peter F. Wiener, Ph.D., Foreword and Additional Sections by Paul Spoerri, Ph.D. Ideally suitable for a textbook of the German language for students of college chemistry and physics. Scientists, chemists, engineers and technical men will also welcome this new, direct approach that includes a handy vocabulary for greater ease.
250 pages 1946 $3.50

ENCYCLOPEDIA OF HYDROCARBON COMPOUNDS. C_1 to C_5 Vol. I
Compiled by Joseph E. Faraday. Ph.D. This first volume deals with hydrocarbons containing one to five carbon atoms. It is presented in a practical loose leaf form, permitting the addition of new sheets in the annual issue that will be offered every year.
416 pages 1946 $15.00

INTRODUCTION TO EMULSIONS
By George M. Sutheim. This timely volume covers the ABC of emulsions, discussing the principles, properties, methods of preparation and practical applications in an easy to read, informal manner.
315 pages Illustrated 1946 $4.75

ORGANIC REAGENTS FOR ORGANIC ANALYSIS
By Hopkin & Williams Research Laboratory Staff. A text on the use of organic reagents in preparing derivatives of organic substances for the purpose of identification by melting points. The systematic arrangement will be a time saver for those looking for the best method of identifying organic compounds.
174 pages 1946 $3.75

CATALYTIC CHEMISTRY
By Henry W. Lohse, Ph.D. A factual presentation of the underlying principles of catalytic phenomena and the application of catalytic reactions in industrial processes are in this profusely illustrated book.
416 pages Illustrated 1945 $8.50

OPTICAL INSTRUMENTS
By Earle B. Brown, Foreword by James G. Baker, Ph.D. A volume thoroughly covering the general field of optical instruments. It discloses the basic principles of design and function as well as adjustment of the various common types.
432 pages Illustrated 1945 $10.00

VAPOR ADSORPTION
By Edward Ledoux. A boon to engineers looking for a clear understanding and methods of application of adsorption phenomena to industrial projects.
400 pages Illustrated 1945 $8.50

ORGANIC CHEMISTRY SIMPLIFIED
By Rudolph Macy, Ph.D. Offers an entirely new approach to fundamental principles of organic chemistry for one-semester college courses. Written in such clear, simple, easy reading terms it can also be used for self-study.
431 pages Illustrated 1943 $3.75

CHEMICAL PUBLISHING CO., INC.
26 Court Street Dept. 1A Brooklyn 2, N. Y.

Physical chemistry for premedical students. **John Page Amsden. New York and London: McGraw-Hill, 1946. Pp. ix + 298. (Illustrated.) $3.50.**

The inclusion of physical chemistry in the already full curriculum of the premedical student has necessitated the writing of textbooks which can be used in a course of only one semester. This book has been written with the object of meeting this demand and treats only those subjects which may be of value to the premedical student. Two admirable features are: (1) the inclusion, as the first chapter, of a discussion of dimensions and units, and (2) a useful correlated list of visual aids at the end of the book. The subjects covered are gases, liquids, electrolytic and nonelectrolytic solutions, chemical equilibrium, hydronium ion, oxidation and reduction, speed of reaction, catalysis, adsorption, colloids, and the Donnan equilibrium. Bronsted's concept of acids and bases and the hydronium ion is used throughout the book. Suggested experiments which may be used as lecture demonstrations are frequently given. The use of the equations developed in the text is illustrated by solved examples. A set of problems of increasing difficulty is included at the end of each chapter. The use of calculus is held to a minimum in the derivation of the equations, and the mathematical requirements of the students are an ability to solve quadratic equations and to use logarithms.

While the scope of the book seems adequate, many incomplete or inaccurate statements and discussions have been noted. Probably the most important of these occur in the first chapter, on units and dimensions. Zero degrees centigrade is defined as the freezing point of pure water at one atmosphere pressure without mentioning the necessity of the water being saturated with air at this pressure; absolute zero is given as − 273.13° C. rather than − 273.16° C.; one calorie is given as equal to 4.187 joules rather than 4.185 joules; the atmosphere is defined in terms of the height of a column of mercury without introducing the concept of the measurement being made at 0° C.; and no clear distinction is made between international and electrostatic units of electricity. Among the incomplete and even erroneous discussions which may easily lead to gross misconceptions are those concerned with the deviations of real gases from the ideal gas laws and with the critical temperature and critical pressure. Other major criticisms concern the statement that the equilibrium constants are a function of the temperature only, and the fact that the experiment described on page 163 does not clearly distinguish between the effect of temperature on the rate of reaction and on the equilibrium. Also, there is no mention of the assumptions made in the solution of such problems as the calculation of the hydronium ion concentration in solutions of a salt of a weak acid and a weak base.

In the opinion of the reviewer the over-all criticism of the book is that too great a simplification has been made of the physical phenomena discussed at too great an expense of accuracy. However, only the author and those who may use this book can resolve this difficulty with respect to the aims of their courses in physical chemistry for premedical students.

Scott E. Wood

Yale University

Advancing fronts in chemistry. **Vol. I: *High polymers.* Sumner B. Twiss. (Ed.) New York: Reinhold, 1945. Pp. 196. (Illustrated.) $4.00.**

In this volume, containing 10 lectures given in 1944, aspects of two general problems are covered: the mechanism of building up of the polymer molecule, and the physical properties of high polymer systems as related to molecular characteristics.

Four lectures are devoted to the first subject. A paper by E. C. Pitzer discusses possibilities of catalytic preparation of important monomers from hydrocarbons and reviews briefly methods of preparation of several industrial catalysts. The inclusion of such material, rarely given in a monograph of this kind, is to be recommended. W. H. Stockmayer considers the kinetics of polycondensation reactions and the formation of branched and cross-linked structures. This chapter should be particularly useful to those desiring an insight into the physical picture, principal results, and assumptions made without following the calculations in detail. Two articles are devoted to chain polymerization reactions. The nature of the initiation catalyzed by free radicals is discussed in detail by C. C. Price. F. R. Mayo's chapter deals to a large extent with effects of the medium in solution polymerization.

Polymer solids and concentrated solutions form the subject of the other six chapters. Two of these, by H. Mark and S. S. Kistler, respectively, contain a general description of features common to all chain polymers as well as some of those which impart to each type a set of characteristic mechanical properties. The situation is examined further in an extensive paper by W. O. Baker, with particular reference to polyesters and polyamides, on the basis of X-ray diagrams, dielectric and mechanical performance. The behavior of concentrated solutions under periodic stress is considered by J. D. Ferry. Detailed attention is given by E. Ott to two parameters, the average degree of polymerization and the molecular weight distribution, as affecting bulk properties as well as thermodynamic and viscosity behavior in solution for cellulose esters. The series is concluded by M. Harris, who discusses the elasticity of wool in relation to chemical structure and its modifications as produced in the laboratory.

This monograph can well be recommended to the research worker in other fields and to the practical polymer technologist who wishes to familiarize himself with some more "theoretical" concepts. Those actively engaged in one or the other phase of polymer research will find the information presented and the references given very useful.

Robert Simha

National Bureau of Standards, Washington, D. C.

SCIENCE

Vol. 103, No. 2686 Friday, June 21, 1946

Physical Thinking and Social Problems

Gregory Bateson

Institute for Intercultural Studies, New York City

THE PURPOSE OF THIS COMMUNICATION is to call the attention of physicists and other natural scientists to the fact that their scientific help is needed in basic research, which must precede the solution of many domestic and world-wide human problems. It is possible that a small number of carefully selected men with experience in the modern handling of natural science problems might, after intensive training in psychological and anthropological methods, make outstanding contributions in the field of social science.

In the last hundred years physics and chemistry have progressed rapidly while social adjustment has lagged behind. We social scientists simply do not yet have sufficient knowledge to cope with the social problems created by the wholesale application of the other sciences. We are shorthanded and overworked. There is a mass of basic research to be done, and yet we are pressed by real emergency to apply the little that we already know. We have not enough basic knowledge of the mechanics of individual aspiration and large-scale political interrelationships to plan the steps which must be taken to adjust human societies to the availability of atomic weapons.

Anthropology and the other sciences which deal with human behavior are just beginning to feel their way toward those concepts which will be nuclear to social science—concepts around which the developing science will crystallize as physics did around the concepts of mass, length, time, energy, etc. We are today in a Baconian or pre-Copernican stage, and yet our progress in the next few years might be very rapid. We have an enormous mass of collected descriptive material and poorly organized hypotheses, and this mass is certainly ready to assume new and more rewarding shapes the moment a few formative ideas are introduced into the system.

In spite of the dangers inherent in analogic thinking, it appears that many of these formative ideas are going to be akin to the sorts of idea which underlie much of modern physics. Man differs much from the entities of physical theory. He metabolizes, he reproduces himself, and, above all, he learns. And yet a strong case can be made for saying that even such protean entities as man and his communities could be profitably studied by scientists trained to elucidate the workings of multiple interdependent variables. Atoms, astronomical bodies, electric circuits, servomechanisms, and computing machines are the only structured entities for which most of the formal epistemological problems have been worked out, and it is therefore reasonable to challenge the experts in these fields to try their skill upon the most complex entities known to exist in our universe.

It is, of course, impossible to guarantee them success in these more complex fields—no scientist can ever be sure that he will solve his problem—but there are indications that the sort of thinking cultivated by modern physicists and mathematicians will be applicable. This statement may be illustrated by enumerating some of the problems which are basic to all social science and some of the limitations which the physicist has in common with the social observer:

(1) The physicist must include the observer and his instrument within the sphere of relevance of the observation. He knows that whatever characteristic (e.g. a velocity) he is measuring, the result can be regarded as "relatively objective" only after all relevant characteristics of the observer (his own position and velocity) have been systematically included. The field anthropologist similarly has learned to be aware of his own relevant characteristics (types of sensitivity, assertiveness, cultural conditioning, etc.) while he observes the corresponding characteristics of another people. He knows that his own character will systematically modify his perceptions and his interpretations and that his behavior may modify that of the people he is observing. (The case of the biologist is somewhat different. While he is studying the liver of a frog, it is not, in general, his own liver which will distort his observations. He is not subject to the systematic circumstance that his observation of any variable will always be a function of his own related characteristics.)

(2) The social scientist often has to deal with systems of reciprocal causation. In their incipient stages such systems may give simple autocatalytic curves, e.g. when the rate of propagation of a given political tenet is proportional to the number of converts. But such systems rapidly become more complicated. The unconverted may become aware of the heretics in their midst and may behave in such a way as to reduce the activity of the converts—or they may actually stimulate that activity. In any case, we have here a type of system which is familiar to the physicist. He can guess at the significance of any systematic change or oscillation in the resulting equilibrium, and he knows what questions should be asked about the time factors inherent in the process.[1]

(3) The social scientist must deal with the problem of "purpose." In the past, our analyses have too often have been phrased in either crudely causal or else crudely teleological terms. Too often we have postulated some sort of Maxwell's Demon (e.g. the "ego"), who should control the switchboard of the central nervous system, and then we have attempted to analyze this creature's character. Within the last few years it is mainly from the electronic physicists and mathematicians that we have obtained clues which will probably resolve the dilemma between crude causalism and teleology. It now appears that all self-correcting behavior and possibly all types of learning must be based on circular or "feed-back" systems such that effects of behavior at a given moment are fed back to modify the causal system which will shape behavior at a later moment (A. Rosenblueth, N. Wiener, and J. Bigelow, *Phil. Sci.*, 1943, **10**, 18). The whole of our teleological phrasings must now be revised, and new and more searching questions must be asked of all apparently adaptive behavior. Many of these questions will be of kinds which occur most easily to minds trained in modern physics.

(4) Recorded human behavior is significant only when the record includes the context. For example, stamping the foot can only be rated as "assertive" in a certain type of context. But we still lack any satisfactory system for classifying such contexts. A beginning has been made in this field by application of topological analysis (Kurt Lewin) to the temporal and spatial relations of preceding and expected events. It has further been argued that acquiring greater facility in learning in a particular type of context, *i.e.*, learning to learn, may be equated with learning to "expect" this type of context. This would imply that learning to learn (deuterolearning) is equivalent to the process of character formation. Further advances in the field of character formation and the classification of contexts could be expected from mathematicians and designers of computing machines, who handle problems of this order.

This series of examples could be multiplied almost indefinitely by referring to such matters as: conditioned reflexes, goal gradients, rote learning, interpretation of psychological tests, interpersonal relations, systems of value and conflicting incentives, systems of libidinal symbolism, and problems of social manipulation. In all of these fields the first steps have been taken toward logicomathematical analysis.

Enough has been said to indicate that the social sciences have plenty of work for physicists and other natural scientists to do. In conclusion, it is worth stressing that "the elimination of war as a means of settling international differences" is a project requiring basic and applied research ranging from learning experiments on rats, through comparative studies of simple communities, up to analysis of the most complex phenomena of contact between contrasting cultures.

---

[1] For analysis of systems of this kind, see G. Bateson's *Naven* (Cambridge Univ. Press, 1986, Chap. XIII) and L. F. Richardson's "Generalized foreign politics" (*Brit. J. psychol. Monogr.*, 1939). It is worth calling special attention to this paper in which a physicist has made important contributions to the social sciences.

Scanning Science—

At a recent meeting of the Board of Regents of the University of Michigan reductions were made in some of the salaries, and several instructors were dismissed. A resolution was adopted that where any department has two or more full professors, only the senior by date of appointment shall at any time receive a salary of more than $2,500. Law and medical professors, if they practice their respective professions, are to receive $2,000, and if they do not, $2,500. The psychological laboratory has been discontinued for one year.

—12 June 1896

Technical Papers

An Intestinal Antiseptic: 2-Sulfanilamido-5-Carboxythiazole[1]

PHILIP S. WINNEK
Pitman-Moore Company, Indianapolis, Indiana

The synthesis of 2-sulfanilamido-5-carboxythiazole was first described in the literature by Backer and DeJonge (*1*), but no information concerning its chemical, pharmacological, or antibacterial properties was given. Like sulfaguanidine, succinylsulfathiazole, and phthalylsulfathiazole, 2-sulfanilamido-5-carboxythiazole is poorly absorbed from the gastrointestinal tract and possesses high antibacterial activity.

Chemistry. 2-sulfanilamido-5-carboxythiazole is a white, crystalline material and is stable in solid form. Samples over two years old have shown no deterioration. Analyses of the thoroughly dried compound give, within experimental limits, theoretical values for C, H, and N. When heated, the substance decomposes with effervescence between 200° and 220° C., depending on the rate of heating and the temperature of the bath when the melting-point tube is inserted. The compound is a fairly strong acid, liberating carbon dioxide when dissolved in sodium bicarbonate solution. Its solubility in water at room temperature (23°–25° C.) is approximately 40 mg. per cent. The pH of the saturated solution is 3.2. The solubilities in water of the mono and the disodium salts are greater than 30 per cent, the pH being 5.4 and 8.5, respectively. The sodium salt of the acetyl derivative has a solubility of approximately 8 per cent, and the pH of the saturated solution is 5.4.

The high solubility of the sodium salts of 2-sulfanilamido-5-carboxythiazole gives a chemical basis for the concentrations of the drug in solution that can be maintained in the intestinal tract. Any 2-sulfanilamido-5-carboxythiazole which is absorbed and which may be partially acetylated in the body will be freely soluble in the body fluids. This suggests strongly that there is little danger of deposition of crystals of the drug or its acetyl derivative in the kidneys or urinary tract, and the expectation has been borne out in all of the experimental work to date.

In vitro studies. The *in vitro* bacteriostatic activity of 2-sulfonilamido-5-carboxythiazole was tested against streptococcus, pneumococcus, and staphylococcus and against members of the colon-typhoid dysentery group, including *Vibrio cholerae*. Results are shown in Table 1. Data obtained with the more commonly known sulfonamides are included.

TABLE 1

COMPARISON OF BACTERIOSTATIC ACTIVITY OF 2-SULFANILAMIDO-5-CARBOXYTHIAZOLE WITH OTHER SULFONAMIDES*

	Lowest concentration (mg. per cent) at which stasis was exhibited at 72 hours					
	SA	SP	ST	SD	SG	SC
Streptococcus (C203)	10.0	5.0	2.5	10.0	10.0	10.0
Pneumococcus (SVI)	2.5	1.25	0.3	2.5	1.25	2.5
Staphylococcus aureus (Barlow)	1280		2.5	5.0		> 160
Escherichia coli	20.0	5.0	0.6	0.6	10.0	5.0
Aerobacter aerogenes	80.0	5.0	2.5	5.0	160	10.0
Salmonella enteritidis	> 80.0	10.0	2.5	2.5	> 80.0	20.0
Shigella dysenteriae (Shiga)	2.5	0.15	0.15	0.15	2.5	0.6
Shigella sonnei	20.0	1.25	0.3	0.6	10.0	2.5
Shigella paradysenteriae (Flexner I)	40.0	0.6	0.6	0.6	20.0	0.6
Shigella paradysenteriae (Flexner II)	40.0	2.5	0.6	1.25	20.0	2.5
Shigella paradysenteriae (Flexner III)	2.5	2.5	0.3	0.3	10.0	2.5
Vibrio cholerae	10.0	1.25	0.15	0.6	20.0	5.0

* SA = Sulfanilamide, SP = sulfapyridine, ST = sulfathiazole, SD = sulfadiazine, SG = sulfaguanidine, SC = 2-sulfanilamido-5-carboxythiazole.

It was found that 2-sulfanilamido-5-carboxythiazole possessed as much activity against streptococcus as did sulfanilamide, sulfadiazine, and sulfaguanidine. Against pneumococcus, it again showed comparable activity with sulfanilamide and sulfadiazine, being only slightly less active than sulfapyridine and sulfaguanidine. It proved more active against staphylococcus than sulfanilamide, while sulfathiazole was the most active of the compounds tested. It showed appreciable activity against the enteric group of organisms, being in general more active than sulfanilamide and sulfaguanidine, and in some instances equal to sulfapyridine, sulfathiazole, and sulfadiazine.

---

[1] The writer acknowledges the assistance of E. R. Bockstahler, H. E. Faith, H. J. Florestano, J. F. Kennedy, and H. E. Martin, Pitman-Moore Company, Indianapolis, Indiana.

In vivo studies. Acute toxicity of 2-sulfanilamido-5-carboxythiazole in mice gave the following results: by oral administration, LD_{50}, 8.0 grams/kg.; intraperitoneal, LD_{50}, 5.0–6.0 grams/kg.; subcutaneous, LD_{50}, 8.0 grams/kg. The chronic toxicity studied in mice, rabbits, and dogs was found to be much less than that of the readily absorbed sulfonamides and sulfaguanidine and comparable with succinylsulfathiazole.

Studies on the absorption following oral administration were carried out in mice, rabbits, dogs, and men. Blood levels obtained in all species were low (e.g. in man given 0.25 grams/kg./day for five days, the maximum blood level was less than 1.0 mg. per cent).

Absorption and excretion studies in man revealed that from 3 to 11 per cent of the 2-sulfanilamido-5-carboxythiazole administered orally was excreted in the urine, the average being 6.1 per cent.

The effect of the compound on reducing the number of coli in the feces of dogs and man was very striking. Comparison of the data with those of Poth, *et al.* (*3*) indicates that 2-sulfanilamido-5-carboxythiazole reduces the number of coli more rapidly and at a lower dose level than either succinylsulfathiazole or phthalylsulfathiazole. In a study of more than 200 patients on succinylsulfathiazole therapy, Poth and his co-workers found that 38 per cent showed less than 1,000 *E. coli*/gram of wet feces within three days of treatment, and that 79 per cent had less than this number within five days of treatment and 93 per cent within seven days. Poth explained that the remaining 7 per cent failed to respond to therapy within seven days because of some condition interfering with the action of the drug. The dosage used by Poth consisted of 0.25 gram/kg. of succinylsulfathiazole as an initial dose, followed in four hours by 0.25 gram/kg. daily, divided in six equal amounts and administered at four-hour intervals. Although the number of subjects on 2-sulfanilamido-5-carboxythiazole was small, it is worthy to note that the most refractory case studied had less than 1,000 coli/gram of feces within 48 hours of treatment at the same dosage employed by Poth. One subject, given one-half the dosage, showed less than 10 coli/gram of feces within 48 hours of treatment. With two subjects on 0.25 gram/kg. daily, omitting the initial dose of 0.25 gram/kg., a count of less than 1,000 coli/gram of feces was obtained within the first 24 hours of therapy. At the end of the second day, both counts were below 10 coli/gram of feces. Thus, in each of the four instances where 2-sulfanilamido-5-carboxythiazole was administered in doses either equal to or decidedly less than that employed by Poth for succinylsulfathiazole, coli counts of less than 1,000/gram of wet feces resulted within two days of treatment.

In an independent clinical study of the compound, Harris and Finland (*2*) report findings that are in general agreement with these. They used the drug in treating cases of bacillary dysentery and state that, in the amounts given, it is poorly absorbed and that, as far as could be determined it is nontoxic. They found the drug to be effective in the cases of dysentery studied and state that it may deserve a place with the other drugs used in enteric infections and in bowel surgery.

Extensive clinical trials at a number of medical centers are now in progress which will establish the value of 2-sulfanilamido-5-carboxythiazole relative to that of other drugs used for intestinal antisepsis.

References

1. BACKER, H. J., and DEJONGE, J. *Rec. trav. chim.*, 1942, **61**, 463.
2. HARRIS, H. W., and FINLAND, M. *Proc. Soc. exp. Biol. Med.*, 1945, **58**, 116.
3. POTH, E. J. *J. Amer. med. Ass.*, 1942, **120**, 265; POTH, E. J., and KNOTTS, F. L. *Arch. Surg.*, 1942, **44**, 208; POTH, E. J., KNOTTS, F. L., LEE, J. T., and INUI, F. *Arch. Surg.*, 1942, **44**, 187; POTH, E. J., and ROSS, C. A. *Texas Rep. Biol. Med.*, 1943, **1**, 345; POTH, E. J., and ROSS, C. A. *J. lab. clin. Med.*, 1944, **29**, 785.

Pectoral Girdles *vs.* Hyobranchia in the Snake Genera *Liotyphlops* and *Anomalepis*

ROSEMARY WARNER

The University of Rochester

The Serpentes have always been considered to differ from all other reptiles in having lost the pectoral girdle completely. Recently, however, Dunn and Tihen (*1*) reported the discovery of a shoulder girdle in a primitive burrowing snake, *Liotyphlops albirostris*. This report seems to warrant further investigation before the interpretation of this structure can be accepted or rejected.

The specimens studied are, in part, the same as those used by Dunn and Tihen. Two specimens of *Liotyphlops albirostris* stained with alizarin red and cleared in glycerine were obtained from Dr. J. A. Tihen. Mr. K. P. Schmidt provided a stained specimen of *Anomalepis dentatus*. Finally, one specimen of *Anomalepis aspinosus*, used for gross dissection, was loaned by Mr. A. Loveridge. The writer is greatly indebted to these authorities for providing the necessary material.

Anomalepis, which is considered a close relative of *Liotyphlops*, possesses the same structure that Dunn and Tihen described in *Liotyphlops*. It is here considered valid, therefore, to apply findings in the former genus to *Liotyphlops* and to the problem originally posed by it.

Dunn and Tihen present evidence to show that (1) a structure at the anterior end of the trachea is the hyobranchial apparatus and that (2) a more posterior element is a vestigial pectoral girdle. The present author believes that there is other, almost incontrovertible evidence that an alternative explanation suggested but not adopted by Dunn and Tihen is the proper one: that the anterior element is the cricoid cartilage of the larynx and the posterior element the hyobranchial apparatus.

The posterior element of Dunn and Tihen was found by gross dissection in a specimen of *Anomalepis aspinosus* measuring 178.4 mm. in total length. The anterior portion of the structure is extremely superficial, while the posterior parts are found imbedded progressively deeper in muscle. The structure is thread-like and shaped roughly like an M whose legs have been bent back upon themselves. It is situated 3.6 mm. posterior to the tracheal opening. The anterior horizontal part is 1 mm. broad and depressed 2 mm. medially. On either side it curves posteriorly to form two somewhat divergent posterior processes. These extend posteriorly for 1.3 mm., at which level they are 1.9 mm. apart, and then recurve sharply to assume an anterior course parallel to the posterior processes and separated from them by .2 mm. The anterior course can be seen for only .6 mm. in this specimen, although in the stained specimen it can be seen to extend as far forward as the level of the central depression in the horizontal portion. The extreme thinness of the apparatus probably accounts for the difficulty of demonstration by gross dissection.

M. geniohyoideus, M. sternohyoideus, M. omohyoideus, and M. hyoglossus are the muscles which Gnanamuthu (*3*) describes as having attachments to the ophidian hyobranchial apparatus. M. geniohyoideus has its origin on the mandible and its insertion on a median raphe, the basihyal and the anterior borders of the thyrohyals (= posterior cornua of the hyobranchium). M. sternohyoideus and M. omohyoideus have cutaneous origins, and have insertions on the thyrohyals. M. hyoglossus has its origin on the hind end of the posterior cornua of the hyoid and passes forward to form the greater part of the musculature of the tongue.

In *Anomalepis aspinosus* all the above muscles are found attached to the structures mentioned. M. geniohyoideus originates on the mandible and inserts on the anterior and anterolateral borders of the horizontal portion and posterior processes of the structure. M. sternohyoideus inserts on the posterior border of the horizontal portion and on the median surface of the posterior processes. It extends caudad to a cutaneous origin. The two remaining muscles—M. omohyoideus and M. hyoglossus—are attached to the portion of the posterior process where it recurves sharply and extends anteriorly. M. omohyoideus inserts on the posterior margin of the bend and runs posterolaterally to its cutaneous origin. M. hyoglossus has its origin on the anterior margin of the bend and runs anteromedially; its right and left divisions converge anteriorly and join each other at the level of the horizontal portion of this element. At this level the two divisions of the M. hyoglossus are firmly bound together by connective tissue and form, with the M. genioglossus, the bulk of the tongue musculature.

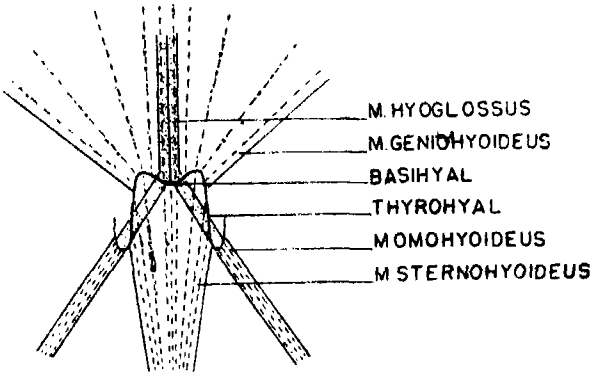


FIG. 1. Hyobranchium and associated muscles of *Anomalepis aspinosus.*

The laryngeal apparatus of serpents consists of dorsal paired arytenoid cartilages which are narrowly continuous posteriorly with the cricoid cartilage. Edgeworth (*2*) cites as exceptions the genera *Boa* and *Python* in which, according to him, the arytenoids articulate with the cricoid instead of being fused with it. The cricoid cartilage is a single structure having a striking Λ-shaped anterior extension on the ventral surface and a more posterior and smaller Λ or Ω configuration on the dorsal surface of the larynx. The cricoid cartilage extends posteriorly and is fused on either side with a variable number of tracheal rings.

Although the arytenoid cartilages cannot be discerned in the stained specimens of *Liotyphlops albirostris,* the cricoid cartilage is distinct. It is the anterior element which Dunn and Tihen interpreted as the hyobranchial apparatus. This cricoid cartilage is in the usual position and has the structure typical of all ophidians. It should be regarded as such.

The combined existence of hyoidean muscular attachments on the posterior element and the demonstration of typical cricoid form of the anterior element indicate that the concept of a pectoral girdle in *Liotyphlops* and *Anomalepis,* intriguing though it is, should be discarded. The structure incorrectly interpreted as a girdle should rather be regarded as a hyobranchial apparatus. It is different from any other hyobranchium ever recorded in snakes, but not different enough to cause concern regarding its identity. A further discussion of its significance is reserved for a later paper.

References

1. Dunn, E. R., and Tihen, J. E. *J. Morphol.*, 1944, **74**, 2, 287–295, Pl. 1.
2. Edgeworth, F. H. *The cranial muscles of vertebrates.* London: Cambridge Univ. Press, 1935. Pp. x + 493. (Illustrated.)
3. Gnanamuthu, C. P. *Proc. zool. Soc. Lond.*, (*B*), 1937, **707**, 1–68, figs.

Interrelations Between Choline, Betaine, and Methionine[1]

H. J. Almquist

F. E. Booth Company, Inc., Emeryville, California

In nutrition there are many examples in which one dietary component reduces the required intake of another which is necessary to maintain normal life. Among these examples two principal classes may be distinguished:

Class 1. Substances which act as precursors for a physiologically required substance, permitting a synthesis of the required substance to any extent necessary. A few examples of this class are: (a) the several vitamin A-active carotenoids which are precursors for vitamin A; (b) methionine as a precursor of cystine; and (c) dimethylethanolamine in replacing dietary choline.

Class 2. Substances which may assume or diminish certain, but not all, functions of a required nutrient and which are not related to the required nutrient as a precursor or complete substitute. Examples of this class are: (a) the well-known effect of fat in reducing the requirement for thiamine; (b) the similar effect of Ca and P on vitamin D, especially in the fowl; and (c) the value of dietary cystine in reducing the necessary methionine level.

These two classes do not include other types of substances which affect the stability, absorption, transport, and utilization of nutrients and for which there already are specific and descriptive designations such as antioxidants and pro-oxidants, poisons, carriers, enzymes, etc. In the present discussion the term "sparing action" is reserved for examples as in Class 2, to the first of which it was applied quite some years ago (*7*).

In examples of Class 2, the "sparing" substance is able either to (1) partially reduce the need for, or (2) provide some, but not all, of the biological functions of the "spared" compound. It is characteristic of these examples, in contrast to those of Class 1, that the replacement does not continue to be effective as the intake of the spared compound decreases, but often becomes sharply limited. In other words, a significant quantity of the spared compound must be present in order that a sparing action may become evident.

In dogs, fat may spare no more than approximately two-thirds of the thiamine requirement (*4*). In promoting calcification, Ca and P are interchangeable with vitamin D over a considerable range, yet all the vitamin D cannot be replaced by Ca and P without incurring additional symptoms of vitamin D deficiency (*8, 19*). Steps in the biological synthesis of cystine from methionine and other precursors have been demonstrated and reviewed in considerable detail (*6*). The reversal of this process does not take place, however, since a definite minimal level of methionine, which cannot be reduced further by surplus amounts of cystine, is needed both by rats (*24*) and by chicks (*2*).

In the rat, choline synthesis from betaine or methionine proceeds readily, *i.e.* the known symptoms of choline deficiency may be relieved by using sufficient of these substitutes (*5, 10, 21*). On the other hand, in the chick, choline synthesis is extremely limited. Methionine does not replace choline in chicks (*9, 11, 13, 20*) or in turkeys (*12*) for preventing perosis when the deficiency of choline is *severe*. A similar statement may be made for betaine in the case of *severe* choline deficiency (*1, 13, 15, 16*). Synthesis of choline in the chick may evidently take place from dimethylaminoethanol, which promotes growth and prevents perosis, but the total synthesis fails somewhere in the stages leading to this compound (*14*).

Chicks grew very slowly on a purified diet which involved a combined severe choline and partial methionine deficiency (*1, 9*). Upon the addition of methionine, the chicks made improved gains which reached a plateau at about two-thirds normal rate. It is noteworthy that the effect of methionine was definitely limited and, with respect to the choline requirement, probably consisted of the provision of methylating capacity but no extensive synthesis of choline. In the presence of ample choline and cystine and a partial deficiency of methionine in the basal diet, improved but limited growth rate was again observed. The evidence suggested that the methionine-sparing actions of cystine and choline were additive under the experimental conditions.

With other sources of labile methyl (methionine and betaine) present in the diet not more than 0.02 per cent choline was needed to support a two-thirds optimal rate of gain. Any choline synthesis which may take place in the chick is probably less than this figure, or not more than 10 or 20 per cent of total requirements. In a recent study, evidence has been produced that the choline requirement of the chick for any given rate of growth on a homocystine-supplemented diet was approximately two-thirds replaceable by betaine (*17*). For optimal gains, chicks required close to 0.06 per cent betaine-irreplaceable choline and 0.14 per cent replaceable choline in the diet. This figure of 0.06 per cent irreplaceable choline is in agreement with an approximate figure of 0.05 per cent found in the presence of surplus methionine or methionine plus betaine (*1*).

---

[1] Condensed from an address delivered at AAAS-Gibson Island Research Conferences, 1945.

Arsenocholine is an analogue of choline which does not methylate homocystine in the rat (*18*) or chick (*3*); however, it is effective in lipotropic activity and phospholipid synthesis (*22, 23*) and will promote growth and prevent choline-deficiency perosis in the chick (*1, 15*). Arsenocholine apparently replaces choline for all the functions mentioned except for that of methylation.

The sparing action of arsenocholine on choline in chicks was very distinct, although definitely limited. It is significant that while the choline-sparing effects of betaine and of methionine were not additive to each other, being of the same nature, *i.e.* methylating capacity, the effect of either one was qualitatively additive to that of arsenocholine (*1*).

A chick diet which is only mildly deficient in choline (0.08 per cent) and approximately adequate in methionine and cystine may be improved for growth and perosis prevention by the addition of betaine or methionine (*16*). In such a diet the effect of methionine and betaine additions may be explained by assuming that both supplements assisted the choline in a methylating capacity, thereby augmenting the supply of choline available for growth and perosis prevention. In other diets in which the choline level (0.03 per cent) was less than the level of essential choline, very little, if any, improvement was noted from methionine or betaine additions. In every case, choline additions elicited strong responses (*16*).

A choline deficiency, like that of many other nutrients, is physiologically a *multiple* deficiency. This is due to the highly varied functions of choline, such as tissue and lipid synthesis, lipotropic action, methylating action, and perosis prevention. Viewed from this standpoint of a multiple deficiency, it is more comprehensible how a compound which can provide only a part of the several functions of choline may still exert a sparing action by releasing residual choline for its other functions.

The results reviewed above furnish illustrations of the principles of the sparing action, which may be briefly summarized as follows:

(1) A sparing action takes place when a nonprecursor compound furnishes or reduces a portion, but not all, of the physiological functions of a required nutrient.

(2) While operating in the relief of one of these deficiencies, the effect of the sparing substance becomes limited or may even be nullified if additional deficiencies come into play.

(3) If several substances can be added which relieve additional deficiencies, the individual sparing actions may be cumulative, at least in a qualitative way.

References

1. Almquist, H. J., and Grau, C. R. *J. Nutrition*, 1944, **27**, 263.
2. Almquist, H. J., and Grau, C. R. *J. Nutrition*, 1945, **29**, 219.
3. Almquist, H. J., and Jukes, T. H. *Proc. Soc. exp. Biol. Med.*, 1942, **51**, 243.
4. Arnold, A. *J. biol. Chem.*, 193[illegible]
5. DuVigneaud, V., Chandler, J. P., Moyer, A. [illegible], and Keppel, D. M. *J. biol. Chem.*, 1939, **131**, 57.
6. DuVigneaud, V., Kilmer, G. W., Rachele, J. R., and Cohn, M. *J. biol. Chem.*, 1944, **155**, 645.
7. Evans, H. M., and Lepkovsky, S. *Science*, 1928, **68**, 298.
8. Fritz, J. C., Hooper, J. H., and Moore, H. P. *Poultry Sci.*, 1945, **24**, 324.
9. Grau, C. R., and Almquist, H. J. *J. Nutrition*, 1943, **26**, 631.
10. Griffith, W. H. *J. Nutrition*, 1941, **22**, 239.
11. Jukes, T. H. *J. biol. Chem.*, 1940, **134**, 789.
12. Jukes, T. H. *J. Nutrition*, 1941, **20**, 251.
13. Jukes, T. H. *J. Nutrition*, 1941, **22**, 315.
14. Jukes, T. H., and Oleson, J. J. *J. biol. Chem.*, 1945, **157**, 419.
15. Jukes, T. H., and Welch, A. D. *J. biol. Chem.*, 1942, **146**, 19.
16. McGinnis, J., Norris, L. C., and Heuser, G. F. *Proc. Soc. exp. Biol. Med.*, 1944, **56**, 197.
17. McKittrick, D. S. Univ. California, 1945. (Unpublished.)
18. Moyer, A. W., and DuVigneaud, V. *J. biol. Chem.*, 1942, **143**, 373.
19. Nowotarski, J. S., and Bird, H. R. *Poultry Sci.*, 1943, **22**, 72.
20. Record, P. R., and Bethke, R. M. *Poultry Sci.*, 1942, **21**, 271.
21. Stetten, DeWitt, Jr. *J. biol. Chem.*, 1941, **138**, 437.
22. Welch, A. D. *J. biol. Chem.*, 1941, **137**, 173.
23. Welch, A. D., and Landau, R. L. *J. biol. Chem.*, 1942, **144**, 581.
24. Womack, M., and Rose, W. C. *J. biol. Chem.*, 1941, **141**, 375.

Scanning Science—

Lord Kelvin's jubilee as professor of natural philosophy in the University of Glasgow was celebrated 15 and 16 June at Glasgow. On the sixteenth Lord Kelvin addressed a group of delegates from England and foreign university bodies.

—12 June 1896

Science Legislation

Forum

This forum is arranged from material selected by the editorial staff from testimony given on 28 and 29 May before the Subcommittee on Public Health of the House of Representatives Interstate and Foreign Commerce Committee.

Science has been endeavoring to keep up to date with the current developments in the Congress related to science legislation. The equivalent of almost three regular issues has been devoted to this subject since 1 January.

Readers of *Science* were informed for the first time on 7 June that a bill proposing a National Science Foundation had been introduced into the House on 15 May and hearings before a subcommittee had been held on 28 and 29 May. Since this new bill, H.R. 6448, was based on the older Senate Magnuson Bill and not on the compromise Kilgore-Magnuson Bill, S. 1850, Watson Davis was caused to remark that the new bill seems to divide again those scientists who favor some kind of Federal support for research.

In the same issue Howard A. Meyerhoff pointed out that the introduction of the new bill was a definite threat to the establishment of a National Science Foundation during this session of Congress and implied that it might be necessary to go through the whole process of compromising the opposing factions all over again.

In order that our readers may be better informed with regard to the issues, the views of Dr. Homer Smith, speaking for the Committee Supporting the Bush report, and the Secretary of Commerce, Henry A. Wallace, are presented here, together with a statement from Dr. Meyerhoff outlining his position as executive secretary of the American Association for the Advancement of Science. The statements of Dr. Smith and Secretary Wallace are somewhat abbreviated. Dr. Meyerhoff's statement was written expressly for *Science*.

Why H.R. 6448 Is the Better Bill

Homer W. Smith
New York University

. . . Despite the preponderant testimony from scientists and those experienced in scientific affairs in favor of the Magnuson Bill, this bill remained in administrative disfavor. At the conclusion of the [November] hearings it was clear that the essential principles for the preservation of the freedom of science, so strongly urged by all of Dr. Bush's committees, were in danger of being completely submerged in favor of political control. There was strong opposition to scientists having anything more than a nominal voice in determining the policies of the Foundation. It was presumed that the top scientists of the country would give generously of their time to act on an advisory committee which had neither authority nor responsibility. It was clear, in short, that the philosophy of the Foundation was to be one appropriate to war mobilization and government direction, and not one appropriate to the peacetime development of science by experienced civilian scientists.

On 14 November a number of scientists met under the chairmanship of President Isaiah Bowman, of The Johns Hopkins University, to discuss the progress of this legislation. At that time it appeared that the essential principles for the preservation of the freedom of science and the protection of the National

(*Continued on page 728.*)

Why S. 1850 Is the Better Bill

Henry A. Wallace
Secretary of Commerce

. . . In my opinion S. 1850 combines the best features of S. 1285 and S. 1297 as well as a number of additional desirable provisions which grow out of the expert testimony presented at the hearings. S. 1850 is in accordance with the President's recommendations on science legislation; H.R. 6448 is in conflict with those recommendations on several important points.

I believe that the following provisions of H.R. 6448 are particularly undesirable:

(1) The bill provides that the powers and duties of the National Science Foundation shall be exercised by a part-time administrative board of nine members appointed by the President with the advice and consent of the Senate. This is substantially the same administrative arrangement as in the original Magnuson Bill in the Senate, S. 1285. A slight compromise has been made, however, by providing that the Director of the Foundation shall be appointed by the President from nomination by the Board, in place of the original provision for a Director appointed by the Board. Since all powers of the Foundation rest in the Board, this compromise is more apparent than real. As I stated in my testimony on the Senate Bills, I am strongly opposed in principle to turning over public functions and responsibilities, and especially the power to allocate public funds, to a part-time board of private citizens. I am in complete agreement with the President's position

(*Continued on page 725.*)

Why I Am Biased in Favor of S. 1850

Howard A. Meyerhoff

Executive Secretary, AAAS, Washington, D. C.

For several months I have been reporting news on science legislation in the pages of *Science*, and I have ventured to add current editorial opinions which were prompted by the news. Some of the opinions expressed were sharp, and it was anticipated that they would evoke protests. They did. The volume, if not the vigor, of the protests has been small, and they usually accuse the writer of bias. This is the reason for choosing the title of this article, which is partly a reply to those critics, but which, it is hoped, will also add something new to the issues under debate.

In early October 1945, several hundred scientists returned questionnaires circulated through the AAAS Council. Over 90 per cent believed that a National Science Foundation should be created. Officially, as executive secretary of the Association, I thereupon attempted to convert this belief into legislation. Several elementary principles had to serve as guides: 1) such legislation must meet the high standards of the scientific professions *and be acceptable to a decided majority of scientists;* 2) it had to be acceptable to the Senate committees sponsoring the legislation and at least to a bare majority in Congress; 3) it had to be acceptable to the Executive Branch of the Government or face a veto.

These principles are so self-evident that they should not need stating, but they have been violated by those who clung so long and so obstinately to S. 1285; by those who believe that S. 1777 is the ideal bill; and by those who currently insist that H.R. 6448 embodies everything scientists should want. It would make no difference whether any of these bills is better than S. 1850 from some special point of view—the great majority of scientists do not think so. Support of any of these other bills at this time violates the first principle; and further, as Senator Saltonstall emphatically stated in an address delivered in Washington on 12 June, it creates the impression of dissension among scientists, and dissension is the precursor of legislative defeat.

I participated in most of the conferences which preceded the formulation of S. 1720 and the ultimate adoption of S. 1850. On the administrative side S. 1850 is the only bill which meets with the approval of experienced legislators.

I witnessed the agreement of the chairman of the Committee Supporting the Bush Report that S. 1850 meets the basic administrative requirements of that group.

I heard the Commissioner of Patents assert that the bill involves *no patent reform or changes*, and industrialists should agree that the systematization of patent procedure in government departments and bureaus for which S. 1850 provides is desirable.

I was present on the two occasions when the patent provisions were altered to give full protection to the rights and interests of manufacturers and industrial laboratories.

I witnessed, with regret and protest, acceptance of limitations on social science, imposed by the Committee Supporting the Bush Report, although two-thirds of the scientists who participated in the AAAS poll favored inclusion of the social sciences.

There is thus embodied in S. 1850 the most careful consideration of every controversial point and the most effective and acceptable solution of each and every issue. Two hundred thirty-two members of the AAAS Council, which includes representatives of most of the 196 organizations affiliated with the AAAS, believe that this is so; only 10 are sufficiently fearful of political control of science to have voted against support of S. 1850. So long as this proportion wants a National Science Foundation, I am strongly biased in favor of the only bill which has given thought to every issue and alone makes an earnest effort to meet minority needs and objections—S. 1850.

---

as expressed in a letter from the Director of the Bureau of the Budget to Dr. Vannevar Bush that in order to make the Foundation "effectively responsible to the President and the Congress it should be headed by a director appointed by the President, who should have full administrative responsibility for the operation of the foundation and its several divisions."

(2) H.R. 6448 does not provide for a Division of Social Sciences, but permits the Board to establish such a division. Nor does the bill provide specifically for scholarships and fellowships in the social sciences. In my opinion the inclusion of the social sciences is too important and fundamental a question to be left to the discretion of the Board and is a proper subject for determination by the Congress. I urge that a Division of Social Sciences be incorporated in the legislation itself.

Both branches of science contribute to national defense and to the general welfare and are, therefore, deserving of Federal support. Moreover, it is generally recognized that the social sciences, which are relatively young, have in many respects not reached the high stage of develop-

(*Continued on page 729.*)

A United Front for S. 1850

Robert Chambers

Union of Biological Sciences

New developments are appearing which go far toward endangering enactment of S. 1850. And it is this bill which combines those provisions of the original Kilgore and Magnuson Bills meeting the approval of the great majority of scientists in this country. The AAAS Council at the St. Louis meeting voted 223 to 10 in support of the bill. Moreover, the Committee Supporting the Bush Report published a statement (*Science*, 1946, **103**, 558), as an appeal to Congress on behalf of the 5,000 scientists who had signed the letter to the President favoring the Magnuson Bill, saying that the Committee endorsed the combined Kilgore-Magnuson Bill, S. 1850. This appeal, with the 5,000 endorsements, was mailed to the President and Congress on 23 April 1946. S. 1850 was approved by a majority of the Senate Committee on Military Affairs and has been on the Senate calendar since early April of this year.

Of the two disturbing factors which have recently appeared, one is the "Minority Views of the Senate Committee on Military Affairs," presented by Mr. Bridges and signed by Senators Austin, Bridges, Wilson, Revercomb, and Hart. This document (Calendar No. 1153, Report 1136—Pt. 2) can be obtained from the Government Printing Office. It attacks several of the provisions in the constitution of S. 1850. It claims that the state responsibility of education and learning will be brought under the domination of the Federal Government, and that the proposed administrator will be a veritable Czar of Science. It is fearful of the strain entailed on the already dangerously overbalanced budget of the Nation, citing as an example of climbing costs that Federal research in 1940 amounted to $70,000,000 and by 1944 was $700,000,000! The absurd criticisms make one wonder regarding the intelligence of the writer of the "Minority Views."

The other disturbing factor is the appearance of a new bill, H.R. 6448 (also obtainable from the Government Printing Office), sponsored by Representative Wilbur Mills. This is actually a revision of the original Magnuson Bill calling for a Board appointed by the President assisted, I understand, by the National Academy of Sciences. In a report which appeared in the *New York Times*, 29 May, the statement is made that the House Bill 6448 is expected to supersede S. 1850. H.R. 6448 attempts to reduce governmental supervision to a minimum; it seriously restricts provisions for a Division of the Social Sciences; it eliminates mandatory geographical distribution of funds to state-supported and land grant colleges, whereas S. 1850 provides for a more thorough distribution of funds throughout the country than we have at present; it eliminates provisions affecting the Government's patent policy which, in S. 1850, has been approved of by those competent to do so. In brief, H.R. 6448 again presents us with a sort of bill already objected to by many who were critical of the original Magnuson Bill. On the other hand, it eliminates those features which were deplored by the Committee Supporting the Bush Report in their recent statement purporting to be an appeal to Congress to enact S. 1850.

H.R. 6448 again opens up the controversy between scientists who had taken sides for and against the Kilgore and Magnuson Bills—a controversy which we had hoped had been settled by a combined bill acceptable to the greatest possible majority. A still worse feature is that hearings were held in Washington on 28 May at which Isaiah Bowman, chairman of the Committee Supporting the Bush Report, and others of the same Committee presented testimonies in favor of the bill. The impression given was that their testimonies constitute the opinion of scientists at large. Why was the Committee appointed by the Council of the AAAS at St. Louis in March not brought into the testimony? The testimony apparently did not include those who were active in revising the Kilgore Bill.

From the 3 May statement made by the Committee Supporting the Bush Report, we read:

> We believe that the creation of a National Science Foundation to support fundamental scientific research and the education of scientists is of the utmost importance for the health, security, and welfare of the nation. . . . Believing the matter to be of great urgency . . . we endorse this bill and appeal now to the Congress as a whole to create a National Science Foundation by the enactment of S. 1850. . . .

Now a few influential members of this Committee appear to be in favor of something which will hamper the very stand the Committee took in the statement just quoted! Senators and Congressmen may introduce difficulties concerning S. 1850, but, at least, the scientists should be unified in the support of a single bill. The one bill which has the widest support is S. 1850.

News and Notes

A discussion of national science legislation, under the auspices of the Washington Association of Scientists, was held in the Commerce Department Auditorium in Washington, D. C., on the evening of 12 June, Phillip N. Powers presiding. Featured on the program were addresses by Leverett Saltonstall, Senator from Massachusetts; Roy K. Marshall, director of the Fels Planetarium, Franklin Institute; and Howard A. Meyerhoff, executive secretary of the American Association for the Advancement of Science. All of the participants spoke in favor of S. 1850, pointing out that this bill represents a reasonable compromise in the matter of creating a National Science Foundation, and urging that scientists present a united front in order that such legislation might be passed at the earliest possible time.

E. Harold Hinman has just returned to the Tennessee Valley Authority, Health and Safety Department, as chief of the Division of Malaria Control. For the past four years he was Chief of Party of the Institute of Inter-American Affairs, Health and Sanitation Division, the first year in El Salvador and the last three years in Mexico. Prior to his departure from Mexico he received the Eduardo Liceaga medal from the Government of Mexico for eminent contributions to public health.

M. Tchou-Su, Institute de Biologie, 393 Route Ferguson, Shanghai, China, is badly in need of reprints, especially in the field of experimental embryology. He was associated with E. Bataillon, at the University of Montpellier, France, for several years and has published extensively.

Hood Worthington, who has been on assignment for the last three years at the Hanford Engineer Works, which the Du Pont Company formerly operated for the Government, has been appointed assistant director of the recently organized engineering research section, Rayon Technical Division, of Du Pont.

Ch. Joyeux, French parasitologist at the Institut de Médecine et de Pharmacie Coloniales, Université d'Aix-Marseille, France, writes as follows:

> It is no longer possible for me to continue my research work. My laboratories were badly damaged during the course of the war, and the great increase in prices prevents further experimental work. I have retired, leaving to younger men the task of reconstructing the laboratory. I shall devote the remaining years of my active life to making scientific expeditions to different countries.

W. Malcolm Reid (Monmouth College)

Alfred Métraux, formerly with the Bureau of American Ethnology, Smithsonian Institution, has been appointed social affairs officer of the United Nations, a newly created office under the direction of Mr. Laugier, Undersecretary of UN.

Col. George C. Crom, Jr., after more than five and one-half years active duty with the AAF, is on terminal leave. Col. Crom's military service was highlighted by his contributions to the development of a wide range of aircraft electrical equipment. He is also credited by Wright Field officials with a major role in the development of 400-cycle power systems for aircraft. His service included tours of duty in Alaska and England in connection with cold-weather tests on turbosupercharger regulators. Col. Crom will continue to serve in a civilian capacity at Wright Field as a research consultant in the Engineering Division's Equipment Laboratory.

Sir D'Arcy Wentworth Thompson, of St. Andrews University, Scotland, was awarded a Daniel Giraud Elliot medal for his book *On growth and form* on 23 April by the National Academy of Sciences.

S. Ansbacher, formerly scientific director of the International Vitamin Corporation and scientific consultant of the American Home Products Corporation, has been appointed director of nutritional research of the Schenley Research Division.

E. G. Stanley Baker, released from service with the AAF as an aviation physiologist, has been appointed assistant professor in the Department of Biology at the Catholic University of America, effective 1 October 1946.

A. Cyril Callister, associate clinical professor of surgery, University of Utah School of Medicine, recently delivered a series of illustrated lectures at the Cardiological Institute of Mexico City, under the auspices of the National University at Mexico City, and at the University of Southern California Medical School. Dr. Callister's subject was: "The Use of Tube Grafts in the Treatment of Deep Complications of Burns."

Announcements

The Empire Scientific Conference of the Royal Society, London, opened 17 June and will extend to 8 July. The Conference opened in London, moves to Cambridge on 22 June, to Oxford on 1 July, and back to London for two closing days. A general description of the program follows:

17 June Opening Ceremony.

18 June General Scientific Organization; papers from Canada, New Zealand, and the Colonies.

experience with legislation that intelligent solutions to the problems presented to the Congress are impossible without statistical and other factual information developed by *social scientists*. The *same situation* exists in private business: increasing numbers of social scientists are being employed in industry and commerce and long-range plans as well as the day-to-day operations of our largest business enterprises are being based on the studies of social scientists. To dismiss the social sciences with a wave of the hand is to discard one of the most important tools for obtaining improved and urgently needed basic knowledge.

(3) H.R. 6448 provides that the disposition of patent rights to inventions and discoveries resulting from research financed by the Foundation shall be left to the discretion of the Board. However, as a guide to the Board, there is additional language outlining the following *general* policy: (1) *inventions in the field of basic* science resulting from research *completely* financed by the Foundation would in general be dedicated to the public; and (2) with respect to inventions in the field of applied science to which the research contractor has also made some independent contribution, the United States would receive only a right to use the invention without cost for governmental purposes.

These provisions give the Foundation positive encouragement and direction to allow private patents on discoveries resulting from research financed by public funds. I am unalterably opposed to these provisions. They perpetuate and give the approval of the Congress to the past and present unsound policies followed by some government agencies. The private research contractors of the Foundation will not be small and independent business enterprises; they will be the big corporations with large and well equipped laboratories which already have a tremendous advantage over their small competitors by virtue of the scientific and technical improvements which they alone can afford to develop and to patent. The provisions of H.R. 6448 will provide government support and financing to the research and patents of big business and lead to further industrial concentration, lessened competition and the stifling of small business and new enterprises. The President in his message to the Congress on 6 September 1945, clearly outlined the only sound public policy on this matter. That policy is to require dedication of all patents resulting from research contracts to the public, with only such narrow and strictly defined exceptions as may be necessary to secure the placing of a few important contracts in exceptional cases where the only qualified contractor will not accept a contract without some provision for private patents on his previous research.

(4) H.R. 6448 makes no specific provision for letting research contracts to other government agencies; yet such agencies—for example, the National Bureau of Standards —may frequently be highly qualified and well equipped to carry on research in a number of important scientific fields. I believe that it would be very desirable to provide explicity in this legislation as an indication of Congressional policy that other Federal agencies may receive funds from the Foundation and that such funds shall be in addition to, and not take the place of, other moneys specifically appropriated to such agencies.

(5) No provision is made in H.R. 6448 for any coordination of the increasing amount of scientific research conducted directly by the Federal Government or financed by Federal funds. On the basis of experience with several important scientific bureaus in the Department of Commerce, such as the National Bureau of Standards, the Weather Bureau, and the Coast and Geodetic Survey, I am convinced that such coordination should constitute one of the principal and most useful functions of a properly organized National Science Foundation. This was also one of the President's principal recommendations in his message to the Congress on 6 September 1945. There is some danger in the period immediately ahead that American science will not suffer from lack of financial support, but from misdirected and conflicting support which will dissipate the energies of our limited number of first-class scientists. There is already the sharpest kind of competition for the services of qualified scientists by the universities, by industry, by the Army and Navy, by the Manhattan Project, and by other government agencies. We are also faced with a great deficit in scientific personnel due to the interruption of the training of young scientists during the war. It will take careful coordination of our scientific effort to make sure that we reserve sufficient qualified scientific personnel for teaching purposes to make up this deficit. The Federal Government cannot and should not determine the scientific programs of private industry and the universities, but it can at least coordinate its own scientific program. I believe, therefore, that any National Science Foundation bill must have a provision for an interdepartmental advisory committee consisting of representatives of the principal government agencies concerned with scientific research. Such a committee would advise and consult with the Foundation and make recommendations to the Foundation and to the President for the coordination of Federal and Federally-financed research programs.

There are several additional provisions of H.R. 6448 which I believe to be undesirable and contrary to sound public policy; and with your permission I should like to submit a supplementary statement on those additional matters for the record within a few days. The bill was introduced and called to the attention of the Department so recently that we have not had sufficient time to consider carefully the legal effects of some of its detailed provisions.

In closing I should like to repeat that while I support wholeheartedly the general objectives of the legislation which you are considering, I cannot endorse H.R. 6448. Many of the specific provisions of this bill, and especially those which I have discussed above, will not foster the progress of free scientific inquiry. On the contrary, they will lead to an increasing monopolization of science by a small clique and operate to the detriment of small and independent business in this country.

In the Laboratory

A Modification of the Ergograph

F. W. KINARD and C. D. COLEMAN
Department of Physiology, Medical College of the State of South Carolina, Charleston

The ergograph is used in physiological and psychological laboratories where it is desired that muscle work be measured and recorded. These instruments are costly and are usually designed to record upon a single type of kymograph or at one height. The ergograph to be described is relatively simple to construct, is durable, and can be adjusted readily to record at any height upon various types of kymographs.

An essential feature of the instrument (*Fig.* 1) is a metal base on one end of which is a wrist support, consisting of a curved wooden block with adjustable metal plates to contact the wrist, and a hand grip. On the other end of the base is a rigid vertical rod. The rod is arranged with a pulley proximal to the hand, another at the top, and two on the distal side. The ring into which the finger is fitted is connected to one end of a stainless steel, flexible, twisted cable by means of a turnbuckle. The cable then extends beneath the proximal and over the uppermost pulleys to end in a loop which is slipped onto a hook on the upper part of the sliding sleeve. This sleeve is constructed with a key or pin which slides in a groove in the rod, permitting free movement up and down but preventing rotation. The sleeve carries on its surface a post with a knurled setscrew which tightens against the stylus to permit vertical and lateral adjustments. The end of the stylus is slotted and has a piece of flexible X-ray film fastened in place by means of a sliding collar. The looped end of a second stainless steel cable extends from the lower hook on the sliding sleeve and across two pulleys, ending in a hook on which the desired weight is hung. A collar is fixed at the desired height on the vertical rod by a setscrew and serves to arrest the sliding sleeve.

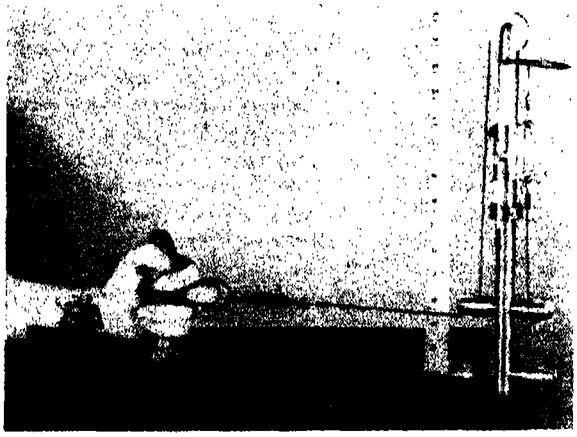


FIG. 1

Operation: The wrist is laid in the support and the hand support gripped. The hand grip is then fixed at a comfortable position, the wrist support adjusted, and one finger placed in the ring. The desired weight is suspended from the hook on the end of the second cable. The stylus is adjusted vertically or laterally until its X-ray film tip touches the flat surface of the kymograph. Exercise is then performed at the rate which is desired, and a kymographic record is obtained of a definite weight being lifted through a measured distance.

Use of Wetting Agents in Histological Fixatives

RALPH L. CHERMOCK and HUGH E. MULLER
Coral Gables, Florida

The quality of a tissue fixative is thought to be enhanced not only by a careful balance of its component ingredients but also by its speed of penetration (*2*). In the past, rapid penetration has been achieved by the addition of such substances as urea, acetic acid, and certain wetting agents (*1*).

To test the validity of the hypothesis that speed of penetration improves the quality of a fixative, a series of carefully prepared, well-known fixing solutions were employed, and to these, three wetting agents were added.

METHODS

Nine widely used fixatives were selected as follows: Zenker's, Carnoy's, Helly's, Bouin's, Allen's, Gilson's, Orth's, and Vandegrift's fluids (*3*), and 10 per cent formalin. All of the above solutions were modified in three ways by the addition of the following aliphatic substances: Tergitol-7; Tergitol-4; and Tergitol-08 (*4*) in the ratio of 3 drops to 100 cc. of fixative. Because of the known characteristics of these three agents in decreasing surface tension, it was hoped that the speed of penetration would be increased.

Because of their histological differences, homogeneous nature, large size, and ready availability, the tissues selected were sheep cerebrums and human liver. Pieces of tissue one inch square were cut and placed in 250 cc. of the aforementioned fixatives for a period of 24 hours. They were then sectioned, and the average depth of penetration of each fixative was measured grossly. Those fixatives containing picric acid and potassium dichromate could be measured by color changes. Methylene blue was added to the colorless fixatives to obtain the same result. Pieces of the fixed areas were then dehydrated, infiltrated with paraffin, sectioned, and stained with Harris' hematoxylin and eosin by standard methods. Those preparations were studied carefully to evaluate the quality of fixation in regard to staining reaction and cellular preservation.

RESULTS

Allen's fluid. The addition of the aliphatics did not appear to affect the speed of penetration of the fixatives, although the addition of Tergitol-4 gave the best fixation and staining qualities in brain tissue.

Helly's fluid. The addition of aliphatics resulted in a decrease in penetration and relatively marked changes in staining reactions. Although the addition of Tergitol-4 improved the staining qualities in liver, it was not as marked in brain. The quality of fixation was not noticeably changed in brain and varied slightly in liver. Tergitol-08 was comparable to Tergitol-4 in most respects, although the nuclear staining was poor.

Carnoy's fluid. There was only slight variation in penetration with the addition of the Tergitols. The fixation qualities were generally decreased, although Tergitol-08 with brain and Tergitol-4 with liver seemed to improve fixation.

Vandegrift's fluid. There was some variation in penetration with the Tergitols added. Thus, Tergitol-4 resulted in less penetration but improved fixation in brain, whereas Tergitol-7 gave equal penetration with improved fixation and less shrinkage. In liver, Tergitol-08 apparently gave maximum penetration; however, Tergitol-4 with decreased penetration showed better fixation.

Gilson's fluid. Penetration was generally improved in brain tissue with the addition of aliphatics. However, fixation was poorer because of the markedly increased shrinkage.

Zenker's fluid. In brain tissue, the addition of Tergitols -4 and -08 decreased penetration but improved fixation. In liver, Tergitols -7 and -08 decreased penetration of the fixatives but slightly improved the fixation and staining qualities of the tissue.

Formalin (10 per cent). The addition of the aliphatics, on the whole, resulted in little improvement. However, Tergitol-4 added to the fixative improved fixation in both liver and brain.

Orth's fluid. The addition of the aliphatics increased the penetration of the fixative, but usually resulted in poorer fixation and greater shrinkage. In liver, the addition of Tergitol-4 improved fixation and staining.

Bouin's fluid. The penetration of the fixative was not affected by the addition of the aliphatics. There was little variation in fixation and only slight changes in the staining reactions of liver and brain.

There was no correlation between the various fixatives, their pH, component ingredients, or supplemental Tergitol, and the degree of penetration or the quality of fixation, staining, and shrinkage. However, we found that Tergitol-4, when added to Allen's, Orth's, Vandegrift's, and Zenker's fluids and 10 per cent formalin, improved fixation and staining (Table 1). Also, Tergitol-08, when added to Zenker's fluid, improved fixation and staining (Table 2). All other combinations of fixatives and detergents showed either no improvement or a decrease in the quality of fixation and staining.

TABLE 1

RESULTS WITH TERGITOL-4 ADDED TO THE FIXATIVES

Fixative	Tissue	Penetration	Fixation	Staining
Allen's	Liver	0	0	0
	Brain	0	+	+
Orth's	Liver	+	+	+
	Brain	+	0	0
Vandegrift's	Liver	–	+	+
	Brain	–	+	0
Zenker's	Liver	+	0	+
	Brain	–	+	+
10 per cent formalin	Liver	0	+	+
	Brain	0	+	0

TABLE 2

RESULTS WITH TERGITOL-08 ADDED TO ZENKER'S

Tissue	Penetration	Fixation	Staining
Liver	–	+	+
Brain	–	+	+

(–) = decreased penetration; (0) = equal penetration, fixation, and staining; (+) = increased penetration, improved fixation and staining.

References

1. Hance, R. T. *Proc. Pa. Acad. Sci.*, 1940, **14**, 114–116.
2. McClung, C. E. *Microscopical technique.* New York: Paul B. Hoeber, 1937. P. 9.
3. Vandegrift, W. B. *Johns Hopk. Hosp. Bull.*, 1942, **71**, 98–111.
4. Wilkes, B. G., and Wickert, J. N. *Ind. eng. Chem.*, 1937, **29**, 1234.

Letters to the Editor

Relative to the B.S. Degree

After a careful reading of the article entitled "Need for a meaningful B.S. degree" (*Science*, 1946, 103, 438), I fail to find any references to the A.B. degree, which is far the more common in the colleges. It has been my experience in placing men in graduate positions over a long period of years that graduate schools give preference to A.B. graduates over those who hold the other degree, mainly because the A.B. degree stands for a larger amount of preparation.

In our own institution, which I believe is typical of most others in its class, requirements for the A.B. in Physics include a major of 25 to 35 hours in that subject, 20 to 25 hours in Mathematics, and 10 to 20 hours in Chemistry. The requirements for a Chemistry major are similar, with the emphasis on that subject.

The trend of the discussion in the article mentioned above seems to imply that those who are employing scientists prefer the B.S. degree. Is that a fair statement of the case?

J. C. Jensen

Nebraska Wesleyan University, Lincoln

The Metric System and the Historical Record

Discussion of the history of weights and measures in "Scanning Science" (*Science*, 1946, 103, 446) and subsequent comment by Arthur Bessey Smith (*Science*, 1946, 103, 634) invite elaboration.

Duplicates of the standard meter and kilogram, now in the custody of the National Bureau of Standards, were brought to this country late in 1889 and on 2 January 1890 President Harrison officially received and opened these prototypes, allotted to the United States as national standards of weight and length. Although that event created considerable interest in scientific circles and induced widespread notice by the daily press, apparently the general public gave no more than passing attention to the advantages of metric units of weight and measure.

Earlier, in 1866, as Arthur Bessey Smith points out, Congress sanctioned use of the metric system and indicated its relation to the system customarily employed. As the result of legislation in that year, no contract or dealing, or pleading in any court, could be deemed invalid on account of reference to metric weights and measures. No metric standards were established, however.

A proposal to legally define the customary units of weight and measure in terms of the metric standards in possession of the National Bureau of Standards was contained in bills introduced by Representative A. R. Somers (H. R. 8974) and the later Senator Royal S. Copeland (S. 3609) in the 75th Congress, second session, 1938. Similar bills had been introduced by the same sponsors in the first session of the same Congress as H. R. 7869 and S. 2789. The import of the proposal may be ascertained from the following excerpt from testimony by Lyman J. Briggs, director of the National Bureau of Standards, at the hearings on H. R. 7869: "By defining the inch and the pound as certain specified fractions of the meter and kilogram, we base our customary system of weights and measures on material standards that have been shown to be highly stable and constant in value. But in doing so we do not for a moment relinquish the units of our customary system of weights and measures. On the contrary, for the first time in the history of our country their values will be definitely established by this legislation."

From time to time use of the metric units of weight and measure has been seriously urged by various groups and members of Congress. One bill to that end (H. R. 10, 69th Congress, first session, 1926) was subjected to extended study, and the hearings were published. This particular bill provided for the use of metric units in merchandising transactions only and allowed businessmen a period of 10 years to make necessary adjustments. A somewhat different objective is exemplified by H. R. 12580, 66th Congress, second session, which was designed to decimalize the customary units though not to replace them by the metric.

The metric system has figured incidentally in occasional legislation to establish standards for special uses. A Federal enactment in 1893, for example, established "the only standard gage for sheet and plate iron and steel in the United States of America." For each number of gage, tables specified the approximate thickness (in inches and millimeters), weight per square foot (in ounces, pounds, and kilograms), and weight per square meter (in pounds and kilograms). The Secretary of the Treasury was required to prepare suitable standards in accordance with this law.

The charge in "Scanning Science" (*Science*, 1946, 103, 446) that Congress has left practically unexercised the power of fixing the standard of weights and measures, granted by the Constitution (and previously by the Articles of Confederation), is perhaps a little too strong, even in reference to the metric units. Review of the pertinent literature discloses that several economically important Federal statutes have been passed under the power referred to, and others under the interstate commerce clause of the Constitution. Federal statutes, standards, or orders relate to a varied list of items which includes barrels and baskets, bills of lading, coins, cosmetics, drugs, electrical measure, foods, metals, packers and stockyards, precious stones, proof spirits, and screw threads.

A present problem more urgent than further Federal legislation is that of achieving greater uniformity in the State laws pertaining to bread, coal, packages of merchandise, weighing and measuring devices, and other commodities or articles of direct concern to the public.

Much of the educational leadership in connection with this problem has been borne by Lyman J. Briggs, Ralph W. Smith, and the late F. S. Holbrook, of the National Bureau of Standards. A Model State Law on Weights and Measures, recommended by both the National Council on Weights and Measures and the National Bureau of Standards, is recognized as the most satisfactory basis for developing sound State or local regulation.

GEORGE W. HERVEY
2347 South Meade Street, Arlington, Virginia

A Dangerous Postwar Development in Science Teaching

Is the teaching of first-year science courses in the colleges and universities of the South to be taken away from the science departments of these institutions? This alarming possibility is proposed in a bulletin, entitled "Studies of higher education in the South," put out by no less an authority than the Committee on Work Conferences of the Southern Association of Colleges and Secondary Schools and currently being circulated for approval by the institutions concerned. The proposal in question is found in Chapter IV, which deals with the teaching of first-year courses in the natural sciences in the postwar era. The following specific proposal is made: "It is further proposed that college and university departments as presently constituted not have control over either methods, subject matter content, or objectives in this phase of general education" (p. 43).

It is significant of present-day trends in higher education to note that no representative of the natural sciences was on the committee which drew up Bulletins VI and VII, Seventh Series, 1946. The opening paragraph of Chapter IV asserts that educators have assigned the natural sciences a place of peerage with the humanities and the social sciences. If the group which prepared this report believes this statement, why were not the natural sciences given some representation on the committee?

There are a number of other disturbing statements made in this bulletin concerning the teaching of science in institutions of higher learning in the South. This note is written to call attention to the fact that the teaching of science is definitely on trial in these postwar days, and that now is the time for scientists to express their criticisms of the unique document under consideration by writing to Dr. Roscoe E. Parker, Executive Secretary, Committee on Work Conferences, Southern Association of Colleges and Secondary Schools, University of Tennessee, Knoxville, Tennessee, prior to the summer meeting of the committee.

JOHN R. SAMPEY
Furman University, Greenville, South Carolina

Death-rate Study on a High Molecular Quaternary Ammonium Compound With *Bacillus metiens*

The few reports appearing in the literature on the germicidal activity of high molecular quaternary ammonium salts against spores indicate a very low order of activity for these compounds, especially when compared with their efficacy against vegetative cells. For instance, alkyl dimethyl benzyl ammonium chloride has been shown to kill spores of *Clostridium tetani* in 20 but not 10 minutes at a concentration of 1: 100 at 20°; of *Bacillus anthracis* in 15 minutes at a 1: 10 dilution; and of *Bacillus subtilis* in less than 30 minutes at a 1: 10 dilution at 37° at pH 8.6 or greater. There are numerous reports to indicate that dilutions of the order of 1: 500 of this compound are not effective against spores. The killing action of alkyl dimethyl benzyl ammonium chloride against spores is enhanced at higher temperatures.

As part of a program of study on the rate of action of high molecular quaternary ammonium compounds against bacteria, preliminary experiments were run against *B. metiens* following the procedure described by Weber and Levine (*J. Amer. publ. Hlth*, 1944, **34**, 719). The suspension of *B. metiens* in distilled water was heated to 80° C. for 10 minutes to kill vegetative cells, and 1 ml. was added to 99 ml. of the proper dilution of the compound to be tested. The solution was stirred throughout the period of test and samples plated at various time intervals. The germicide used was alkyl dimethyl 3,4-dichloro benzyl ammonium chloride (Tetrosan), and the tests were made at 20° at pH 7.

A 1: 10 dilution of Tetrosan was found necessary to kill *B. metiens* at 20° when tested by the FDA method. The killing dilution of Tetrosan against spores by the FDA method is of the same order as that of alkyl dimethyl benzyl ammonium chloride. A comparison of this killing dilution with the data on death-rate studies emphasizes the striking percentage reduction in the number of spores obtained with dilutions as low as 1: 5,000 and 1: 20,000. These high dilutions seem to kill a large number of spores (60–75 per cent) almost immediately, with a subsequent marked reduction in the rate of killing. Even after six hours only about 90 per cent of the organisms are killed. These results provide an indication that the FDA method does not give a complete picture of the germicidal action of a compound.

It is difficult to reconcile the data obtained with the concept of a logarithmic order of death. Actually, the experiments seem to demonstrate that the original population is made up of spores of very different resistance and that the death-rate pattern is due to the individual resistance.

The results of preliminary experiments, using the same technique with Tetrosan and cetyl trimethyl ammonium bromide, against *Staphylococcus aureus* parallel those obtained with spores. Whereas the killing dilution of these compounds against *Staph. aureus* is of the order of 1: 50,000, when determined by the FDA method, death-rate studies indicate that over 90 per cent of the organisms are killed immediately by dilutions as low as 1: 300,000. These experiments are being extended and will be published in a more detailed form at a later date.

ADRIEN S. DUBOIS and DIANA DIBBLEE
Onyx Oil & Chemical Company, Jersey City

Aspergillus or What?

We have before us (*Science*, 1946, 103, 116) G. W. Martin's reproofs concerning our use of the generic name *Aspergillus*. We are quite familiar with the history of the names used for this group of molds. We are likewise quite aware that neither Wiggers in 1780 nor Link in 1809 knew that the perithecia they were using to describe *Mucor herbariorum* and *Eurotium herbariorum*, respectively, were developed on the same mycelium as the old *Aspergillus* which Micheli studied in his herbarium specimens. It is equally certain that Fries never bothered to study this subject—he left it just as Link did. By the time DeBary (1854) showed that the perithecia of *Eurotium* developed from the same mycelium as the conidial heads of *Aspergillus*, the number of species involved was considerable, and naturally only a few accepted the fantastic transfer of such strictly conidial forms as *Aspergillus niger* and *Aspergillus flavus*, which are cosmopolitan, to *Eurotium Aspergillus niger* and *Eurotium Aspergillus flavus!* If the ascosporic forms were the only Aspergilli at stake, the advocation of a strict interpretation of the letter of the arbitrary rule relating to the nomenclatorial precedence of the perfect stage might be tolerated.

Nothing is lost to taxonomy if, instead of abandoning nearly 100 years of study of the Aspergilli before *Eurotium* was concocted, we simply amend Micheli's description to show that here and there among this multitude of species and strains a few groups actually produce ascospores. No one who has examined as many herbarium specimens as we have in our search of the beginnings of the study of the Aspergilli can fail to grasp the idea that we have merely completed Micheli's diagnosis of his genus. We doubt if any worker has examined the treatment of these molds by Micheli, Wiggers, Persoon, Link, Fries, DeBary, and more recent workers any more closely than we have. We equally doubt if any other mycologists have examined half the number of strains of *Aspergillus* in laboratory culture, or from natural sources, that have been handled by us. We are convinced that more nomenclatorial stability is to be attained by adding recognization of ascus formation in sections of Micheli's genus *Aspergillus* than could be reached by perpetuating the mistakes of Link and the negligence of Fries.

We do not defer to any man in our loyalty to the ideal of stable nomenclature, but with a background of years of experience and the examination of thousands of natural specimens and pure cultures, we stand by the conclusion that the general use of *Eurotium*, *Sterigmatocystis*, *Diplostephanus*, *Emericella*, etc. would only add confusion and difficulty without serving any constructive purpose. Why should the worker have to deal with multiple genera when a single one, and the oldest, will suffice? International recognition of *Aspergillus* for both ascosporic and conidial forms would constitute the logical and, we feel, correct solution.

CHARLES THOM
Port Jefferson, Long Island, New York

KENNETH B. RAPER
Northern Regional Research Laboratory, Peoria, Illinois

HANDBOOK OF LIZARDS

By Hobart Muir Smith

This new volume in the HANDBOOKS OF AMERICAN NATURAL HISTORY series is the first full treatment thus far published of lizards occurring in the United States and in Canada. The book considers 136 species of lizards under the following topics: range, type, locality, size, color, scalation, recognition characters, structural features, life history, habitat and habits, methods of collection and preservation, and problems for future study.

Illustrations, numbering more than 300, consist of photographs of practically all species and subspecies, line drawings and range maps. Also included are illustrated keys to all the families, genera, species and subspecies of North American Lizards.

"The Comstock Publishing Company and its editors are to be congratulated for Dr. Smith's work and for making available the series HANDBOOKS OF AMERICAN NATURAL HISTORY which in my estimation are without peer in subject matter, typography and general presentation in the scientific field."—ARTHUR M. GREENHALL, Director, Portland Zoological Park, Portland, Oregon.

557 pages, $5.75

ORDER FROM YOUR BOOKSELLER OR

COMSTOCK PUBLISHING CO.
INCORPORATED
124 ROBERTS PLACE
ITHACA, NEW YORK

Book Reviews

Chromosome atlas of cultivated plants. **C. D. Darlington and E. K. Janaki Ammal. London: Allen and Unwin, 1946. Pp. 397. $2.75.**

The major portion of this volume is devoted to a catalogue of the chromosome numbers of some 10,000 species of cultivated plants—a work which should prove of inestimable value to investigators in many fields of the plant sciences. It is the most comprehensive contribution of its kind to have appeared since Gaiser's compilation in 1930 and brings well up to date the results of several hundred investigators throughout the world. By applying the term "cultivated" in a liberal sense the authors have included not only crop plants, drug plants, and ornamentals but also such groups as parasites, carnivorous plants, stocks used for fruit and flowering trees, latex plants, plants used for tools, weapons, etc., as well as those which furnish cork, herbicides, resins, and the like.

The families, genera, and species are arranged in systematic order according to the Bentham and Hooker system, which has the advantage of bringing together groups with related chromosome ratios. Beside each species is given its common name (when it has one), its somatic chromosome count, a reference to the literature, a symbol indicative of the use of the plant, and a statement of its geographic origin.

An introductory section contains a stimulating discussion of the origin of cultivated plants based in part upon the work of Vavilov and in part upon conclusions to which the authors' work has led them. Emphasis is placed on the fact that the center of diversity of many crop plants has shifted and that in many cases there has been not one region of hybridization and selection but several. The "snowball" effect of migration on variety is discussed, and some of the guiding principles of plant breeding, as determined by chromosome behavior, are elucidated.

JOHN M. FOGG, JR.

University of Pennsylvania

Die Methoden der Fermentforschung. **(Vols. I–IV.) Eugen Bamann and Karl Myrbäck. New York: Academic Press, 1945. Pp. xx + 3388. (Illustrated.) $65.00.**

Until one really digs into this set of volumes he cannot truly appreciate the tremendous task which the authors undertook and accomplished. The only word which can adequately describe the work is "encyclopedic." It is encyclopedic in the sense that it covers every field that in any way pertains to research in enzyme chemistry. One almost feels, while perusing the volumes, that they were written from the viewpoint of making them the only books necessary on the shelf of the enzyme chemist.

These volumes are photo-offset reproductions of the originals, published and distributed by authority of the Alien Property Custodian. The paper and bindings are excellent. The work is essentially European in origin, the various sections (all written by authorities in their respective fields) coming largely from western Europe. A small proportion was written by English authors, with less than 3 per cent emanating from the United States. It is unfortunate for those who might have wished to purchase certain volumes separately not only that the breaks between volumes come at illogical points, but that all of the literature references and indexes are collected together in Volume IV, thus making this volume essential to the value of all of the others.

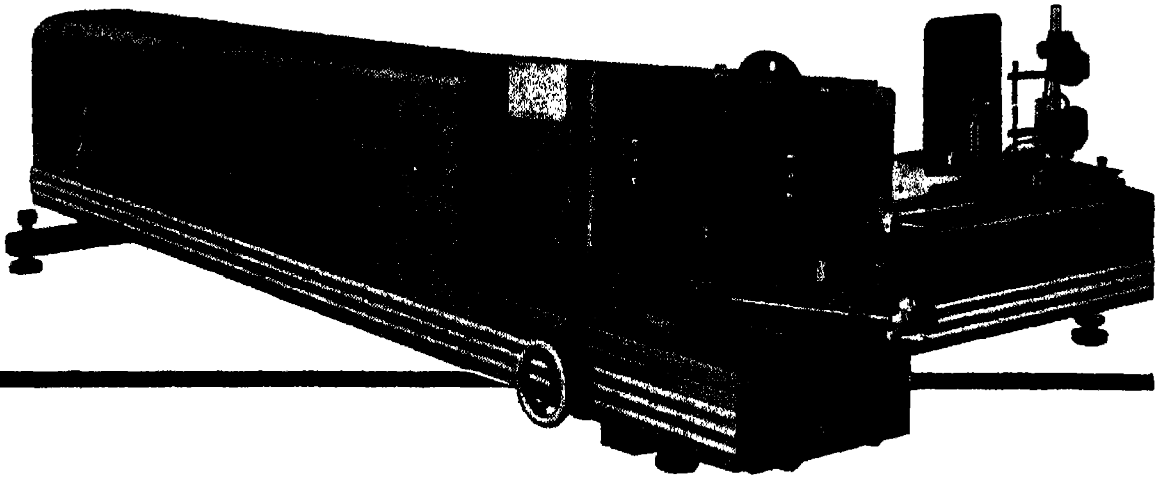
Volume I begins with a short introduction, in which the definitions, nomenclature, and classification of enzymes are discussed. Approximately 400 pages are then devoted to the chemistry of the substrates, intermediates, and end products of enzyme actions. Each section of this portion discusses the synthesis (where possible), isolation from natural sources, some of the chemical reactions, and, finally, certain of the physical properties of the substances in question. These substances range from glycerides, starch, cellulose, and proteins to nucleic acids, tannins, chlorophyll, acetylcholine, and acceptor dyes. While the chemistry is not as complete as one would find in monographs, it gives a very satisfactory background to the nonspecialist. Six pages, for instance, are devoted to a discussion of the structural chemistry of the proteins.

The next phase of the subject to be taken up is that of methods—largely those of a physicochemical nature. Nearly 60 pages are devoted to a discussion of the use of X-rays in the determination of the structure of organic substances. There follows a series of sections devoted, among other subjects, to absorption spectra, Raman spectra, fluorescence, polarography, dielectric constants, ultracentrifugation, diffusion, sublimation, and the determinations of melting points and molecular weights. These chapters are not in the least superficial. They delve into the underlying physical principles and develop the fundamental mathematical equations where such are germane to the subject.

The second section of Volume I goes into the subject of catalysis and reaction rates, with discussions of all of the various means of measuring the latter, including polarimetry, refractometry, spectroscopy, and the use of the interferometer. Theories of buffers, pH, and redox potentials are developed. These even go into such detail as to describe, with illustrations, how to platinize an electrode. Finally, there is a lengthy discussion of the free energy of reactions, and several sections devoted to the microanalytical procedures used for the quantitative assay of many of the participants in enzyme reactions.

Volume II is devoted largely to the preparation, isolation, and characterization of enzymes and includes sections on the preparation of enzymes from bacteria, algae, yeasts, molds, and protozoa, as well as from more conventional animal and plant materials. The major por-

BAUSCH & LOMB LARGE LITTROW SPECTROGRAPH



PROVIDING three times the linear dispersion of the Medium Quartz Spectrograph, yet occupying but little more space, the Large Littrow Spectrograph permits work of the highest accuracy, both qualitatively and quantitatively. The crowded spectra of alloy steels, tungsten carbide alloys, stellite, and other materials are easily resolved with this instrument. With the quartz system the spectrum from 2100 A. to 8000 A. has a total length of about 700 mm. Adjustments are so arranged that any one of ten sections, each ten inches long, can be photographed, bringing any desired spectrum line near the center of the plate. For longer wavelength work a flint glass system is available. This provides a wavelength range of 3500 A. to 10,000 A. and approximately three times the dispersion of the quartz system. For complete information send for B&L Catalog D-20. Bausch & Lomb Optical Co., 642–6 St. Paul Street, Rochester 2, N. Y.

BAUSCH & LOMB
ESTABLISHED 1853

tion of the volume is devoted to the hydrolases (carbohydrases, nucleases, and amidases). This section continues on into Volume III, without a break, to take up the proteases and "thrombase" (including a discussion of blood coagulation).

Volume III then goes on with the desmolases, including a lengthy discussion of alcoholic fermentation. Following this are found chapters on a wide variety of enzymes which participate in oxidation-reduction reactions, including such typical representatives as the cytochromes, peroxidase, catalase, and hydrogenase.

The latter part of Volume III is devoted to lengthy sections on assimilation in plants and bacteria, antienzymes, model enzymes, the place of enzymes in medical chemistry (including cancer), and finally, a large section on the industrial uses of enzymes. Included in the more than 200 pages devoted to this subject are discussions of such representative topics as the use of enzymes in the baking, fermentation, fat, milk, and pharmaceutical industries.

Volume IV, as mentioned above, is largely made up of a bibliography of over 6,000 references, some of them referring to early 1940 literature. The inclusion of many references under subnumbers, obviously added at a later date, indicates the effort of the authors to make these volumes completely up to date. Included also are complete author and subject indexes and, finally, three pages of corrections.

This set of four volumes represents an extremely valuable addition to the chemical literature. It is essentially a compendium of information, no effort having been made to be critical of the cited literature. To the enzyme chemist, as well as to the general biochemist, it is well worth possession.

ROBERT D. COGHILL
Abbott Laboratories, North Chicago, Illinois

A textbook of bacteriology and immunology. **Joseph M. Dougherty and Anthony J. Lamberti. St. Louis: C. V. Mosby, 1946. Pp. 360. (Illustrated.)**

This small, attractively bound book is described in the Preface as an effort "to simplify the various phases of bacteriology and immunology, for the purpose of securing the interest and enthusiasm of the average student." The guiding philosophy is stated as "the resolution of all difficulties from the viewpoint of the student." Bacteriology and immunology are covered in only 313 pages; a section of 31 pages on parasitic protozoa follows. The text is written in a clear, straightforward style, and there are especially helpful chapters on the microscope, quantitative titrations, and the blood. Otherwise, the book generally follows outlines that are traditional.

Unfortunately, a considerable amount of the limited textual material is given over to technical directions for laboratory work, and still more space is devoted to descriptions of the older rather than of the newer concepts of microbiology. Attention to historical matters, and omission of much relatively new information, is especially noticeable in the chapters on the pathogenic microorganisms and on immunity. For example, no mention is made of active immunization against tetanus. In the immunology section the diagrams showing Ehrlich's side-chain theory, which were so conspicuous a feature of early treatises on immunity, are reproduced. The reviewer had never again expected to see these pictures in a modern textbook or to find the inaccurate ideas prevailing in the infancy of immunology again set forth in detail. At the same time, the basic physicochemical phenomena now recognized as actually responsible for *in vitro* antigen-antibody reactions are not clearly described. The fundamental subject of hypersensitivity is not discussed at all, and although there are separate chapters on filtrable viruses and on rickettsiae, nothing is said about such common virus infections as measles, influenza, or encephalitis, or about endemic (flea-borne) typhus.

The reviewer is in sympathy with the commendable aims of the authors to present a brief text that promotes the cultural values inherent in the study of bacteriology and that simplifies matters so that the average student can easily comprehend them. This book, however, omits so much of the newer, significant knowledge that it leaves the reader with an inadequate understanding of various phases of up-to-date microbiology. Even so, it does succeed in condensing much useful information and doubtless will appeal to undergraduate students, for whom it was designed.

KENNETH L. BURDON
Baylor University College of Medicine, Houston, Texas

The Svedberg, 1884–1944. **A. Tiselius and Kai O. Pedersen. (Eds.) Uppsala, Sweden: Almqvist and Wiksells, 1945. Pp. 731.**

This is a contribution to commemorate the 60th birthday of the distinguished Swedish scientist, The Svedberg. There are 55 chapters or papers (mainly in the field of chemistry and chemical engineering) by 70 authors: 37 papers are in English, 11 in German, 5 in Swedish, and 2 in French. Because this volume was projected and prepared during the war years when free communications with colleagues in other lands were difficult, if not impossible, all but two of the authors are Swedes, although Dr. Svedberg's great contributions to chemistry and to chemical industry are known the world over. Some of the chapters give us glimpses of Dr. Svedberg's challenging life and extraordinary labors and achievements. Hardly anything makes Dr. Svedberg as happy as "planting a young seedling and watching it grow."

This volume, published by the aid of 21 Swedish industrial organizations in honor of an outstanding scientist in the field of chemistry and chemical engineering, is a reminder that the size of a country is no measure of the caliber of that country's citizens, be they scientists or statesmen.

A. J. CARLSON
University of Chicago

SCIENCE

Vol. 103, No. 2687 Friday, June 28, 1946

The Multiple Factor Theory of the Control of Respiratory Ventilation

John S. Gray[1]

AAF School of Aviation Medicine, Randolph Field, Texas

DURING THE PAST FIFTY YEARS a number of theories concerning the regulation of the respiratory minute-volume have been proposed. Although none of these theories has met with universal acceptance and none has been amenable to quantitative expression, it is of interest to review briefly their development as an introduction and background to the theory herein proposed.

The various theories proposed up to 1925 have one characteristic in common: they place respiratory ventilation under the control of a unique chemical agent whose effective concentration is located in the arterial blood. In the order of their proposal, these theories attribute the control of ventilation to the arterial oxygen tension, the arterial carbon dioxide tension, and the arterial hydrogen-ion concentration (*3, 10, 13*). There are, however, insurmountable objections to each of these theories. For example, the arterial pO_2 theory explains the respiratory response to anoxia, but affords no explanation of the respiratory responses to exercise, acidosis, alkalosis, or carbon dioxide inhalation, for there are no appropriate changes in the arterial pO_2 in any of these conditions. Similarly, the arterial pCO_2 theory explains the respiratory response to the inhalation of carbon dioxide, but provides no explanation for the changes in ventilation which accompany exercise, acidosis, alkalosis, or anoxia, for in all these conditions the alterations in arterial pCO_2 are in the wrong direction. Finally, the arterial H-ion theory explains the respiratory changes in metabolic acidosis and alkalosis, but fails to explain the responses in exercise, anoxia, or carbon dioxide inhalation; in anoxia the arterial H-ion concentration moves in the wrong direction, and in exercise and carbon dioxide inhalation the changes, although in the right direction, are wholly inadequate in degree. In summary, each of these theories merely restates the single phenomenon upon which it is based and fails completely to provide any understanding of other equally important phenomena.

The above conclusion, expressed forcefully and in some detail by Gesell in 1925 (*3*), provided the point of departure for new approaches to the problem of the regulation of respiration. Theoretically, there are at least three ways in which the difficulties of the above theories may be avoided.

(a) The principle that a unique chemical agent in the arterial blood is the only "true" stimulus to the respiratory center may be retained, but extended by assuming that final control of respiration depends upon variations in the irritability of the respiratory center towards this unique agent. Nielsen's (*13*) theory is an example of the application of this alternative.

(b) The principle may be retained that respiration is controlled by a unique chemical agent, but its effective concentration may be located elsewhere than in the arterial blood. Gesell's (*3*) theory is an example of the application of this alternative.

(c) The principle of a unique chemical agent may be rejected and replaced by the principle that a number of agents exert independent effects upon respiration and that the net ventilation under any given condition is determined by the sum of the partial effects of the separate agents. This alternative is the basis of the present multiple factory theory.

It is profitable to analyze examples of the first two alternatives. Nielsen's theory states (a) that carbon dioxide is the unique stimulus for the respiratory center, and (b) that the respiratory responses to exercise, acidosis, and anoxia are mediated by increased irritability of the respiratory center to the diminished CO_2 level. The first of these tenets is mistakenly based upon the experimental observation that CO_2 elicits a greater respiratory response per unit change in pH than other acids. The actual observation of responses to both stimuli denies Nielsen's conclusion of *unique* potency of one of them. The second tenet follows inevitably from the first, for, if CO_2 is the unique stimulus, and if, as Nielsen so nicely demonstrated, the CO_2 level is decreased in anoxia, acidosis, and exercise, one is compelled to interpret the accompanying respiratory responses as increased irritability to CO_2. In order to provide proof for such changes in irritability, he plotted the relationship between alveolar pCO_2 and ventilation in subjects breathing various percentages of carbon dioxide under conditions of rest, exercise, anoxia, and ammonium chloride acidosis. The resulting curves in the different conditions proved to be linear with the same slopes but with significantly different positions. The constant slopes reveal that a given increment in stimulus produces the same increment in response regardless of the conditions: this is evidence of unaltered irritability. The simple change in position suggests the influence of an additional factor, operating independently of CO_2. The two essential tenets of Nielsen's theory are therefore without experimental foundation. In spite of the fact that the theory considers carbon dioxide to be the only "true" stimulus to the respiratory center itself, it does introduce the notion that a number of factors are involved in the final control of respiration.

---

[1] On leave from the Physiology Department, Northwestern University Medical School, Chicago, Ill.

Gesell's original theory (*3*) stated that respiratory ventilation is controlled by the H-ion concentration within the respiratory center itself. This theory also preserved the principle of a unique respiratory stimulus and at the same time avoided the objections to the arterial H-ion theory. The improvement, however, is more apparent than real, for the H-ion concentration of the cells of the respiratory center is still beyond measurement. Nevertheless, the theory did emphasize the possible consequences of a lack of parallelism between arterial and cellular concentrations of stimulating agents, which may occur in transitory disequilibrium states, and in conditions of markedly altered blood flow.

With the discovery of the role of chemoreceptors in the carotid and aortic bodies, Gesell modified his theory to include indirect activation of the center through outlying sensory receptors (*4*). Furthermore, oxidation processes as well as H-ion concentrations within the cells are considered important in the activation of sensory receptors, both central and peripheral. This modified theory is no longer primarily a theory of the over-all regulation of respiration; rather, it is primarily a theory concerning the intracellular mechanisms by means of which certain agents, involved in the control of respiration, bring about stimulation or activation of receptor and effector cells. The two types of theory, however, are neither mutually exclusive nor competitive, but complementary.

THE MULTIPLE FACTOR THEORY

The preceding theories for the most part may be called single factor theories, for they embody the principle of a unique stimulus for respiration or for the respiratory center. The fact that such theories have so consistently met with failure suggests a closer scrutiny of the principle of a unique stimulus. As a matter of fact, the poverty of direct evidence in favor of this principle stands in contrast to the wealth of homely evidence in favor of the opposite principle, that numerous factors influence respiration. The possibility that respiration is controlled by the integrated action of a number of factors has been repeatedly suggested, among others by Yandell (*12*) and Lawrence (*11*) Henderson and Bernthal (*1*) and more recently by Comroe (*2*). In fact, if Nielsen's theory (*13*) is divested of its postulates concerning a "true" stimulus and its site of action, it becomes a multiple factor theory. However, no one appears to have pursued this principle to its logical conclusions and to have attempted to apply it in a quantitative fashion. The present multiple factor theory is an attempt to do this.

In formulating the multiple factor theory it is important to distinguish clearly between the over-all regulation of respiration for homeostatic purposes and the intimate cellular mechanisms involved. The present theory is an attempt to describe quantitatively the integrated action of the various factors which control respiration, regardless of their sites of action or mechanisms. Like thermodynamics, it is concerned with the beginnings and ends of processes and not with the intervening steps, however important the latter may be from other standpoints. Since the multiple factor theory does not specify the site or mode of action of the various factors concerned, it will not stand or fall as a result of new developments along these lines. It should, in fact, serve as a useful guide in formulating and interpreting experiments designed to elucidate such mechanisms.

The multiple factor theory is based upon three *fundamental principles*, the first of which may now be stated explicitly. *The multiple factor principle states that a number of factors exert independent effects upon respiratory ventilation.*

The first step in the application of the multiple factor principle is to attempt to identify the various factors concerned. Since the administration of fixed acid, the inhalation of CO_2, and the withdrawal of O_2 result in increased ventilation, it is proper to consider these three chemical agents as possible factors. The recent demonstration that reflexes arising in exercising muscles bring about an increase in ventilation suggests an additional factor to be considered. The list should also include pressoreceptor reflexes from the great arteries and great veins; thermoreceptor reflexes, presumably from the hypothalamus; and finally, pain reflexes and psychogenic reflexes. Of the above factors, the four most important ones, at present, appear to be three chemical agents and the muscle reflexes.

The second step in the application of the multiple factor principle is to decide at what point the concentrations of the three chemical agents are to be measured. Although ideally their concentrations should be measured in the respiratory center and the peripheral chemoreceptors where they exert their effects, this is not feasible. Venous blood levels are unsuitable because of the extreme variability in the composition of venous blood. Neither mixed venous blood nor blood from any accessible vein reliably reflects conditions both within the respiratory center and in outlying chemoreceptors. The only remaining possibility is arterial blood. There are also positive reasons which favor this choice. First, the chemoreceptors of the carotid and aortic bodies are believed to be exposed to arterial blood. In addition, parallelism between concentrations in arterial blood and in the respiratory center is promoted by the carefully regulated cerebral circulation. Finally, external respiration directly controls the gaseous composition of arterial blood. Accordingly, the most feasible approach is to correlate respiratory ventilation with the arterial concentration of the three chemical agents, bearing in mind the possibility that difficulties may arise in transitory unsteady states and in conditions of seriously altered blood flow.

It should be made clear that the multiple factor principle does not require that the partial effects of the separate agents be quantitatively fixed and invariable. The respiratory mechanism may, for example, be depressed by narcotic drugs and fail to exhibit a normal responsiveness to one or more of the respiratory factors. Such changes in sensitivity, however, should be demonstrated as an alteration in the slope of the stimulus-response curve of the partial factors in question.

A study of the behavior of the several agents selected above reveals that they are interrelated. Although, in accordance with the multiple factor principle, they may be considered to exert independent partial effects on ventilation, *they are not independent of one another*. It is well known, for example, that the arterial O_2 tension, CO_2 tension, and H-ion concentration are all elevated by the inhalation of CO_2 and depressed by the inhalation of air deficient in O_2, although in both instances ventilation is increased. It is known further that the increase in ventilation resulting from the administration of acidifying salts is accompanied by an increase in arterial O_2 tension and H-ion concentration and a fall in CO_2 tension. Finally, any reflex which increases ventilation without a corresponding increase in CO_2 production by the body as a whole will lead to acapnia and alkalemia. It is therefore apparent that the various respiratory agents influence one another to such an extent that a change in one agent alone rarely occurs either physiologically or pathologically. These observations provide the basis for the second principle of the multiple factor theory. *The interdependence principle states that a change in any one of the respiratory factors usually brings about changes in one or more of the other factors.*

If it is true that under most circumstances several factors are exerting independent but simultaneous influence on respiration, some method of combining the separate effects to represent the total effect must be adopted. The simplest device is to take the algebraic sum of the partial, or separate, effects to yield the total or combined effect. The necessity of specifying the algebraic sum arises from the fact that certain of the chemical agents are capable of inhibiting respiration, a situation represented by a negative partial effect. The total ventilation, of course, can never be negative, but the partial effect of an inhibitory agent may be considered negative. This flexibility and simplicity of the algebraic summation principle favors its adoption over that of a more complex device, such as taking the product of partial effects, which would imply synergistic action of the agents. The latter procedure should be avoided until actual evidence of synergism is encountered. This brings us to the third principle of the multiple factor theory. *The algebraic summation principle states that the actual ventilation is defined as the algebraic sum of the partial effects of the separate agents.*

It follows from the above principles that several types of effects on respiration must be carefully distinguished. A partial effect is the effect of a single agent when all other agents are kept constant. The actual ventilation rarely, if ever, represents a single partial effect. If all the partial factors are operating in the same direction, the actual ventilation represents an *additive* effect; if in opposite directions, a *difference* effect.

For the multiple factor theory to be successful as a theory it must be possible (a) to isolate and quantify the partial effects on ventilation of each of the important factors concerned, (b) to quantify the interrelationships between the various factors concerned, and (c) to demonstrate that algebraic summation of these partial effects does correctly predict the actual ventilation under various conditions.

During the past several years considerable progress has been made in completing the above phases in the quantitative development of the theory. The first step consisted of the derivation on formal grounds of what has been called the alveolar equation (*5*, *8*), which defines all possible relationships between alveolar (or arterial, since the two have been shown to be in equilibrium) O_2 and CO_2 tensions for any barometric pressure, alveolar RQ, and for any inspired gas mixture. This equation, like the others presented in Table 1, is fairly complex in its most general form, but happily reduces to much simpler forms for specific applications.

TABLE 1

EQUATIONS AND MATHEMATICAL SYMBOLS

1. The general alveolar equation (relationship between pO_2 and pCO_2):

$$pO_2 = \frac{(B\text{-}47-pCO_2)(RQ\cdot FO_2+FCO_2) - pCO_2(1\text{-}FO_2(1\text{-}RQ))}{RQ+FCO_2(1\text{-}RQ)}$$

2. The general formal ventilation equation (relationships between actual ventilation and pCO_2):

$$VR = \frac{47\ MRR(RQ+FCO_2(1\text{-}RQ))}{pCO_2-(B\text{-}47)\ FCO_2}$$

3. The general respiratory pathway equation (relationships between H-ion and pCO_2):

$$pCO_2 = \frac{H}{53.3}[(16+2.3\ O_{2_{150}})\ (\log H-1.59) + BHCO_{3_{7.41}} + 0.375(O_{2_{150}}-O_2)]$$

4. The chemical ventilation equation (giving the sum of the partial effects of H-ion, pO_2, and pCO_2 on ventilation):

$$VR = 0.22H + 0.262\ pCO_2 - 18.0 + \frac{105}{10^{0.038pO_2}}$$

pO_2, pCO_2 = alveolar or arterial tensions of O_2 and CO_2, respectively
FO_2, FCO_2 = volumetric fractions of O_2 and CO_2 in dry inspired air, respectively
B = barometric pressure
RQ = alveolar respiratory quotient
VR = alveolar ventilation ratio (excluding dead space ventilation) expressed as the ratio of actual alveolar ventilation to resting alveolar ventilation
VR_{pO_2}, VR_{pCO_2}, VR_H = alveolar ventilation ratio as it is influenced solely by the factor or factors identified in the subscript, all other factors remaining constant; partial ventilation ratio
VR_R = partial ventilation ratio due to action of muscle reflexes
H = H-ion concentration of arterial plasma; pH = − log H + 9
$BHCO_{3_{7.41}}$ = bicarbonate content in vols. per cent of plasma from oxygenated blood at a pH of 7.41
O_2 = oxygen content of blood in vols. per cent
$O_{2_{150}}$ = oxygen capacity of blood in vols. per cent expressed as O_2 content of blood exposed to a pO_2 of about 150 mm. Hg
MRR = metabolic rate ratio, expressed as the ratio of the actual metabolic rate to the resting rate

The second step consisted of an analogous derivation on formal grounds of what has been termed the formal ventilation equation (*8*), which defines the possible relationships between the actual ventilation and the alveolar CO_2 tension for any condition of metabolic rate, alveolar RQ, and inspired gas mixtures.

The third step consisted of developing on empirical grounds what has been called the respiratory pathway equation (*9*), which defines the possible relationships between the arterial H-ion concentration and CO_2 tension, for any conditions of bicarbonate capacity, O_2 capacity, and arterial O_2 saturation.

The fourth and latest step to be completed consists of the isolation and quantification of the partial effects on ventilation of the three important chemical agents, H-ion, pCO_2, and pO_2. The partial effects of H-ion and pCO_2 were established empirically on the basis of extensive data available in the literature on the composition of blood in both respiratory and metabolic disturbance of acid-base balance. The partial effect of pO_2 was similarly established on the basis of extensive data (*6*), on the composition of alveolar air in decompression anoxia. These separate partial effects may be summed to yield what has been identified as the chemical ventilation equation (*9*).

The variables VR, H, and pO_2 may be eliminated from the chemical ventilation equation by substitution of the previous three equations, thereby providing a quantitative description of the behavior of respiratory ventilation under any conditions where the three chemical agents, operating normally, are controlling ventilation.

One of the major achievements of the present theory is that it resolves the most persistent and controversial question in the field of respiration: Should H-ion or CO_2 be considered the true respiratory stimulus? From the standpoint of the multiple factor theory this question should be framed as follows: To what extent does each of the two agents influence ventilation? Equation 4, which accurately describes the extensive experimental data, provides a quantitative answer to this question. If it were true that only one of the two agents is the true stimulus, the procedure used to establish Equation 4 would have betrayed the fact by emerging with a coefficient of zero for the inactive agent. Since neither of the coefficients is zero, it must be concluded that both agents independently affect respiration.

The combined action of the two agents, H-ion concentration and pCO_2, is illustrated in Table 2 by data which were calculated from the equations presented above and which accurately describe experimental findings. The first line of the table represents the normal resting condition, and the next two lines represent respiratory and metabolic acidosis, respectively. In all three conditions the metabolic rate ratio is unity; although there are changes in O_2 tension, the range covered is an inactive one for this agent. The inhalation of 5 per cent CO_2 elevates both the CO_2 tension and the H-ion concentration. Since the partial effects of both agents are stimulatory, a vigorous respiratory response occurs, amounting to a 268 per cent increase over the resting value. This marked response to the inhalation of CO_2 is, of course, well known. By contrast, an identical increase in H-ion concentration due to a metabolic acidosis, induced by NH_4Cl or any fixed acid, results in a comparatively feeble respiratory response, amounting to only 9 per cent. The reason for this becomes apparent from an examination of the behavior of the CO_2 tension. The increase in ventilation mediated by the acidemia leads to hypocapnia, which exerts an inhibitory partial effect (indicated by a negative sign in Table 2), which nearly neutralizes the partial effect of the acidemia. It is important to note that the partial effect of the H-ion is identical in both types of acidosis, indicating unaltered sensitivity, but that in one type its action is assisted by the accompanying hypercapnia and in the other it is hindered by the accompanying hypocapnia.

TABLE 2

Condition	Arterial pO_2	Arterial pCO_2	Arterial reaction		Metabolic rate ratio	Partial increments				Total ventilation ratio
			H-ion	pH		VR_{po_2}	VR_{pco_2}	VR_H	VR_R	
Resting	104.1	40	38.9	7.410	1.00	...	...	...	...	1.00
5% CO_2 inhalation ..	140.8	46.7	43.1	7.336	1.00	0.00	1.75	0.93	0.00	3.68
NH_4Cl acidosis	107.8	36.8	43.1	7.336	1.00	0.00	– 0.84	0.93	0.00	1.09
Anoxia, 12,170 ft. ...	49.0	36.8	36.6	7.436	1.00	1.44	– 0.84	– 0.51	0.00	1.09
Passive exercise	121.1	28.6	30.7	7.516	1.00	0.00	– 2.99	– 1.81	5.20	1.40
Active exercise	104.1	40.0	38.9	7.410	6.20	0.00	0.00	0.00	5.20	6.20

Study of these data in Table 2 leads to the conviction that any attempt to explain them in terms of only one of the two arterial agents is doomed to failure. If, nevertheless, one insists upon the existence of a unique stimulus, be it H-ion or pCO_2, one is then compelled to assume fortuitous alterations in responsiveness to this stimulus. All these objectionable features are avoided simply and logically by the multiple factor approach.

The fourth line of Table 2 illustrates the combined action of all three chemical agents in anoxia resulting from exposure to altitude. At 12,170 feet, breathing atmospheric air, the reduced O_2 tension, operating through the chemoreceptors, increases the respiratory minute-volume. This respiratory response leads to hypocapnia, which in turn produces an alkalemia. The final increase in ventilation, as is well known, is relatively small, amounting in this example to only 9 per cent. The reason for this small response is that the partial effects of both the hypocapnia and alkalemia are inhibitory and nearly neutralize the partial effect of the anoxic stimulus.

The lack of a satisfactory explanation of the intense respiratory response to exercise has been a serious deficiency of previous theories. Although analysis of this problem in terms of the multiple factor theory has not been completed, the usefulness of this approach may be indicated by the following preliminary analysis. It has recently been demonstrated that a purely reflex respiratory response occurs in passive exercise (*2*). Since the response, however, is so small in comparison to the response to active exercise, it has been considered to play a negligible role in active exercise. That this conclusion is wholly unjustified is indicated by the calculations presented in the last two lines of Table 2. It has been reported (*2*) that passive exercise of one leg in human subjects produces an average increase in ventilation of 40 per cent. If it can be assumed that the passive nature of the exercise prevents any change in metabolic rate, it can be calculated that a considerable hypocapnia and alkalemia must have resulted. Since the reflex increased ventilation against the marked inhibitory action of these changes, it must have been quite powerful—in fact, so powerful that, acting alone, it should increase ventilation by 520 per cent. When this reflex is operating under more normal conditions of active exercise, it should not meet with opposition, for the metabolic rate and CO_2 production should be increased. The last line of Table 2 shows that, granted a reflex of this same intensity in active exercise, it should be able to handle a 520 per cent increase in metabolism without any disturbances in gas transport, or disturbance in the levels of gas tensions or pH. Contrary to the original conclusion, this analysis implies that the muscle reflexes may play a major role in mediating the respiratory response to exercise. It further implies that the chemical agents play a minor role in this situation, an implication which certainly is in harmony with experimental observations on the behavior of these agents in exercise. It may be tentatively concluded that in exercise the chemical agents carried by the blood stream provide (a) a fine adjustment of ventilation, automatically brought into play when the reflex response is not otherwise exactly commensurate with the increased requirements for gas transport, and (b) the adjustment required as compensation for the metabolic acidosis of severe exercise.

The multiple factor theory has already proved its usefulness in the analysis of respiratory problems in aviation. It provides accurate estimates of O_2 requirements at various altitudes (*5*), of equivalent altitudes breathing various percentages of O_2 (*7*), and provides a basis for determining the effects of adding CO_2 to various gas mixtures at altitude (*8*). It has also afforded a quantitative description and explanation of the mean pathways for disturbances of acid-base balance (*9*). It promises to reveal additional insight into acclimatization to altitude and into the various stages of compensation to acid-base balance disturbances.

References

1. Bernthal, T. *Annu. Rev. Physiol.*, 1944, **6**, 155.
2. Comroe, J. *Physiol. Rev.*, 1944, **24**, 319.
3. Gesell, R. *Physiol. Rev.*, 1925, **5**, 551.
4. Gesell, R. *Annu. Rev. Physiol.*, 1939, **1**, 185.
5. Gray, J. S. *AAF Sch. Aviat. Med. Proj. Rep. No. 131*, 12 April 1943.
6. Gray, J. S. *AAF Sch. Aviat. Med. Res. Rep. No. 290*, 15 July 1944.
7. Gray, J. S. *AAF Sch. Aviat. Med. Res. Rep. No. 291*, 19 July 1944.
8. Gray, J. S. *AAF Sch. Aviat. Med. Res. Rep. No. 310*, 26 August 1944.
9. Gray, J. S. *AAF Sch. Aviat. Med. Proj. Rep. No. 386*, 7 May 1945.
10. Haldane, J. S. *Respiration.* New Haven: Yale Univ. Press, 1922.
11. Henderson, L. J. *Blood: a study in general physiology.* New Haven: Yale Univ. Press, 1928.
12. Henderson, Y. *Physiol. Rev.*, 1925, **5**, 181.
13. Nielsen, M. *Skand. Arch. Physiol.* (Suppl. No. 10), 1936, **74**, 87.

Technical Papers

Radioactivation of Colloidal Gamma Ferric Oxide

M. Blau and H. Sinason

Research Department, International Rare Metals Refinery, Inc., New York City

O. Baudisch

Director of Research, Saratoga Springs Commission

Welo and Baudisch (*7*) were the first conclusively to establish that ferric oxide—Fe_2O_3—exists in both a cubic and a rhombohedral form. The cubic form, γ ferric oxide, is the labile one and ages slowly, under loss of energy, into the stable rhombohedral form, the common α Fe_2O_3 or hematite. The cubic or spinel type, γ Fe_2O_3, possesses magnetic properties similar to, but feebler than, metallic iron and, in addition, a remarkable number of catalytic and biocatalytic qualities. The rhombohedral, α Fe_2O_3, which is not magnetic, is also active in a biocatalytic manner but to a lesser degree than the cubic form.

It is obvious that the difference in physical behavior of the two chemically identical modifications of iron oxide must be attributed to the difference in their crystal structure. Many investigators have studied the crystal structure of these iron oxides (*6*). The result of these investigations was the discovery that the lattice in the structure of γ Fe_2O_3 is incomplete. The lattice of γ Fe_2O_3 contains so-called "interstitial spaces" (atomic holes) which, in the more stable lattice of α Fe_2O_3, are filled up by ferric ions. The elemental crystal of γ Fe_2O_3 contains an average of 21⅓ ferric ions compared to an average of 24 found in the crystal of α Fe_2O_3. This was ascertained mainly by a number of experiments dealing with the diffusion of liquids and gases in these crystals. It was found, for instance, that radium emanation diffuses freely through the "atomic holes" in γ Fe_2O_3 crystals, while α Fe_2O_3 is almost impenetrable to this emanation; in this case, the "atomic holes" are blocked at room temperature. The diameter of these "atomic holes" or channels in γ Fe_2O_3 ranges between 5.2 A. and 7.5 A., as the benzene molecule (diameter, 5.2 A.) may penetrate the crystal, but the xylene molecule (diameter, 7.5 A.) is unable to do so.

The fact that the cubic, ferromagnetic iron oxide possesses these "atomic holes" is of great significance, since within the crystal a secondary structure, or "inner surface" is formed. The comparatively great surface of this crystal is mainly responsible for the high catalytic reactivity of the material. Also, the "atomic holes" create electric disturbances within the crystal which may also influence the reactivity of the compound.

The properties of γ Fe_2O_3 remain unchanged when put into a colloidal state (*1*), and it is in this form that it is especially suitable for certain biological purposes. Colloidal solutions were prepared with a colloid mill, using as a carrying medium dextrin, olive oil, and gum arabic; the particle size obtained was 10^{-5} cm. or smaller.

Gamma ferric oxide in colloidal form may be injected directly into the blood stream. Peyton and Beard (*5*) found that the colloidal particles of γ Fe_2O_3 are taken out of the blood stream by the reticulo-endothelial cells, which are phagocytic to foreign materials of this type. These authors first isolated Kupffer's cells (reticulo-endothelial cells of the liver) by passing a sodium chloride solution through the liver and then using an electromagnet to separate the cells, the latter having been transformed into living magnets by the absorption of colloidal γ Fe_2O_3 particles. These reticulo-endothelial cells are distributed throughout the body, but are most abundant in the liver, spleen, and bone marrow. They play an important role in the case of chronic inflammations, in the repair stage of acute processes, and in blood diseases. Colloidal gamma iron oxide has no toxic effects on the living cells; the cells proliferate and, after some time, have eliminated and are entirely free of all the iron particles.

It is easily seen that the reticulo-endothelial cells in the body can be influenced and their antibody actions stimulated if the colloidal γ Fe_2O_3 particles are combined with some therapeutically acting material, such as certain radioactive substances. A method of doing this is the main subject of the present article.

Experimental Evidence

It was first thought that radon gas (radium emanation) might be used as the radioactive substance with which to activate the colloidal γ Fe_2O_3 particles, but this proved to be impractical, since radon cannot be stored in this type of crystal because of the "atomic holes" in the lattice (which are responsible for the good qualities of γ Fe_2O_3 as an emanator). The idea of using radium itself as the activating material had to be discarded, as injections with Ra are not permissible. This also was the objection to the use of polonium, which is highly toxic unless used in infinitesimal quantities.

It was therefore necessary to look elsewhere for a radioactive substance which would be an alpha radiator, which could be deposited easily and firmly on and within γ Fe_2O_3, and which had a short half-life in order to avoid dangerous aftereffects.

The active deposits of radon—Ra A, Ra B, and Ra C—were finally chosen as activators. Ra A is an alpha-ray emitter with such a short half-life (3.05 minutes) that its activity, in this case, is negligible; Ra B, with a half-life of 26.8 minutes, is a beta- and gamma-ray emitter; and Ra C, with a half-life of 19.7 minutes, is the most potent alpha and gamma radiator in the radium series. Depositing Ra A, Ra B, and Ra C in equilibrium conditions onto another substance, Ra C (the substance in which we are predominantly interested for our experiments), would decay approximately with the half-life period of Ra B.[1]

Experiments were then made with the object of finding a suitable method of deposition of the radioactivating substances on and within the colloidal γ Fe_2O_3. Generally, activations with the active deposits of Ra emanation are done by an electrical method. The substance to be activated is exposed to the emanation in an electrical field, in which the substance itself has to serve as the negative electrode. This method, although feasible in our case because of the metallic properties (conductivity) of iron oxide, which means that it could be used directly as the negative pole, was not employed, because the yield of such an exposure is small and the active deposit does not adhere very firmly. In addition to the preceding objections, it would only be possible to activate the surface layer of the exposed colloidal powder, an area which would be entirely insufficient in our case.

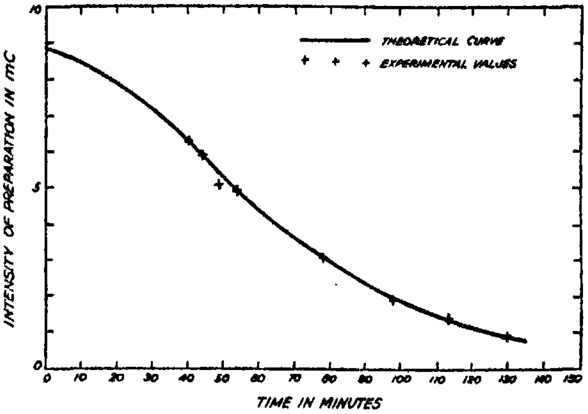


Fig. 1

For the above reasons another method of activation, similar to that first used by H. Petterson (*4*) for the activation of metallic disks, was adopted.

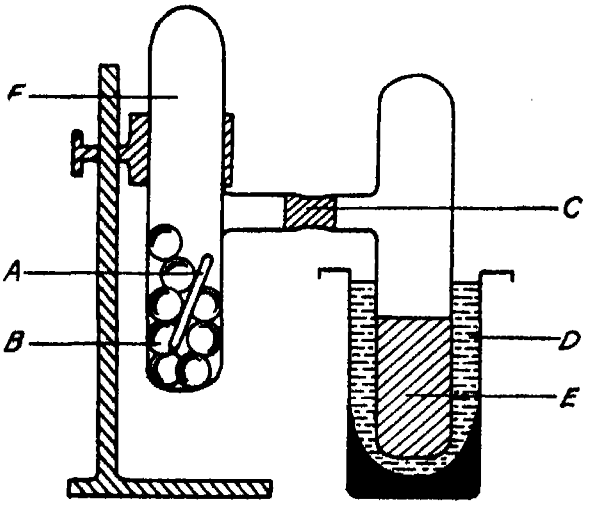


Fig. 2. A—glass capillary enclosing Ra emanation; B—metal shot; C—filter; D—liquid air; E—colloidal γ Fe_2O_3.

The pyrex glass apparatus shown in Fig. 2 was used for the activation of our compound. Into Tube E a small quantity (approximately 5 grams) of colloidal γ Fe_2O_3 powder was introduced, and the top of the tube sealed hermetically. The powder was then heated to about 150° C. while evacuating the apparatus through Tube F, in order to eliminate all possible gases that may have been absorbed in the powder and which might clog the atomic channels within the crystals. Care was taken to keep the temperature at 150° C., since too high a temperature would result in the transformation from gamma to alpha iron oxide. This too may be controlled by testing the colloidal material for its magnetic properties (absent in α Fe_2O_3) after the initial heating.

---

[1] Ra C is formed by the decay of the longer-life product, Ra B, and will disappear approximately with the decay of Ra B.

Tube F contains a thin glass capillary which in turn encloses a known amount of Ra emanation. Tube F also contains a few metal shots.

After the powder in Tube E has been sufficiently heated, Tube F is sealed, care being taken to maintain the vacuum in the system. The apparatus is then shaken mechanically until the shot contained in Tube F has broken the glass capillary and freed the emanation.

The radon is now distributed equally throughout the apparatus, so that only part of the radioactive gas is in contact with the colloidal powder. It is possible to concentrate Ra emanation onto another substance by freezing. The temperature required for this is rather low, and liquid air had to be employed as a cooling agent. The part of Tube E containing the colloidal γ Fe_2O_3 was immersed in liquid air so that the radon might freeze upon the powder. The emanation concentrated in this manner has to remain in contact with the powder for three and one-half to four hours until equilibrium is reached between the emanation and its active decay products.

Taking into account the atomic channels of γ Fe_2O_3, it is evident that the emanation will have close contact not only with the surface but also with the interior of the crystal lattice of the powder particles. After allowing the necessary time for the attainment of equilibrium, the apparatus is broken, and the remainder of the emanation present is discarded. The powder is again heated (again the temperature is to be maintained at less than 150° C.) to drive off any emanation that may be present in the channels of the powder or particles. The active deposit—Ra A, Ra B, Ra C—adheres very firmly to the powder as it is hammered onto the particles by two successive alpha disintegrations. The colloidal γ Fe_2O_3 powder may now be dispersed in any liquid medium suitable for injection therapy.

In order to establish a definite method of dosage, the activity of the powder has to be measured before injection. Taking these measurements at different time intervals assures that we are really dealing with Ra B and Ra C and provides a definite check as to whether or not all the emanation is evaporated from the powder.[2] How completely this purpose was accomplished may be seen from the points plotted on the decay curve of Ra C (Fig. 1). The points on the curve correspond to the values of Ra C obtained when measured by its gamma radiation. The curve was drawn in accordance with the theoretical values for the decay of Ra B–Ra C after four hours exposure in decaying radon. The starting point of the curve and the absolute values of the ordinates are extrapolated from experimental values for the moment at which the emanation was discarded. The fact that all the experimental points are very close to the curve proves that no radon remained in the colloidal powder and that the extrapolation to the zero point is correct. This zero point, which gives the activity of Ra B–Ra C reached by the exposure in radon, is a measure for the yield of the above process of activation.

Various other experiments, using γ Fe_2O_3 of different particle sizes, were made with the result that the best yield was obtained, as expected, with the material in colloidal state. Without taking any special precautions, a yield of 90 per cent was easily obtained. Certain of the experiments performed in order to ascertain the preceding may be of interest.

The behavior of powdered γ Fe_2O_3 was compared with that of colloidal γ Fe_2O_3, using the type of apparatus described above but adding an extra tube in order to have similar conditions for the two compounds used. About 15 times as high a yield was obtained for the γ Fe_2O_3 powder as for the colloidal γ Fe_2O_3, although the surface of the colloidal powder is much larger. The reason for this was later found to be the following: The colloidal γ Fe_2O_3 was prepared with mineral oil as a carrying medium. The mineral oil was later removed with petrol ether and the solid colloidal γ Fe_2O_3 heated to 150° C. Traces of the oil were, however, not completely evaporated, since care was taken not to exceed the 150° C. temperature mark. This oil clogged the atomic channels and prevented the radon from penetrating within the lattice of the powder particles. Although mineral oil has, at ordinary temperatures, a strong adsorption for radon, this seems not to be the case for very low (liquid-air) temperatures, at least not in comparison with the adsorption coefficient of Fe_2O_3.

Another experiment was undertaken in order to differentiate the adsorption factors of gamma and alpha ferric oxide. In order to have the same colloidal conditions present throughout, we used the same colloidal γ Fe_2O_3, transforming half of the amount into α Fe_2O_3. This was done by heating the γ Fe_2O_3 to about 400° C., after which the powder showed only a very slight magnetic reaction, proving that at least 95 per cent of the total amount had been transformed from the gamma into the alpha modification. The three-tube arrangement on our apparatus was again used to make possible a full comparison of the results. It was found that the yield in amounts of Ra B–Ra C adsorbed was from 40 to 50 per cent higher in the case of $\gamma\ Fe_2O_3$, calculated for equal quantities of powder. As the formation of the active deposit depends upon the adsorption of emanation (all adsorption phenomena are surface effects), this result means that the "inner surface" of the $\gamma\ Fe_2O_3$ powder in colloidal state is from 40 to 50 per cent greater than the surface of the alpha modification. Taking into consideration this great surface of colloidal $\gamma\ Fe_2O_3$, we can now understand why this material, in the colloidal state (average particle size, $0.1\,\mu$ in diameter), has such great catalytic efficiency.[3]

---

[2] Presence of radon within the powder not only would falsify the dosage required for the treatment but also might be dangerous if used in large quantities.

APPLICATION

We believe that there is no limit as to the charge of Ra B–Ra C that may be applied with the colloidal $\gamma\ Fe_2O_3$. The quantity of Ra B–Ra C desired can be easily obtained, depending only upon the initial quantity of Ra emanation used and upon the time elapsing between the discarding of the emanation from the powder and its injection into the blood stream. In order that the powder may have sufficient activity when used for injection therapy, it may remain in contact with the emanation until the last moment and so may be shipped to distant places if the part of the apparatus containing the powder is kept at a low temperature by either liquid air (in a thermos flask) or dry ice (solidified CO_2). It was found that when dry ice (– 60° C.) is used, approximately 50 per cent of the emanation may be fixed to the powder. The quantity of Ra B–Ra C to be used in the treatment may be calculated in advance as long as the initial quantities of radon, the time of storage in the apparatus or shipping, and the time elapsed between the opening of the apparatus and the application of the powder are known, so that an exact dosage is possible at all times.

An important advantage of colloidal $\gamma\ Fe_2O_3$ lies in the fact that it may be suspended in an aqueous medium and so be used for intravenous injections. The activated iron oxide powder is an alpha, beta, and gamma radiator; injected into the blood stream, it enters (as already mentioned) the reticulo-endothelial cells. The alpha particles emitted by the powder will be absorbed, almost entirely within the cells, all the energy being transmitted to the cells. The amount of beta and, especially, gamma radiation absorbed in the same cells is negligible in comparison with the alpha radiation. Not even 1 per cent of the ions formed in the cells will be due to beta radiation; and the number of ions produced by gamma radiation is only about 0.01 per cent of those produced by alpha particles. For that reason we can suppose that within the cells only the alpha radiation is biologically active; the tissue near the cells will receive beta radiation, while the action of the gamma radiation is spread over the entire body. Because of the strong and concentrated action of the alpha particles, however, we can limit the intensity of our preparations to very low values, so that the effect of beta and gamma radiation is of no importance.

If using preparations of 1 mc. (Ra B and Ra C), we have within the cells, by alpha action, ionization effects which with the common Ra therapy could be produced only with a preparation of 10 grams of Ra.

It is to be presumed that the highly activated reticulo-endothelial cells will be more effective in their action against bacteria and inflammatory diseases. These cells are distributed throughout the body, but are found especially in organs connected with the blood formation.

Leblond and Lacassagne (*3*), using subcutaneous injections of polonium in experiments with rats, proved by autographic methods the presence of polonium within reticulo-endothelial cells upon the lymphatic formations and also found a pronounced effect upon the lymphatic system. They recommend the use of polonium for the treatment of lymphatic leukemia. However, since polonium is toxic and produces gastric ulcerations, it would be desirable to replace it by activated $\gamma\ Fe_2O_3$, as described above. The use of the colloidal gamma iron oxide activated with Ra B and Ra C is preferable even to artificial radioactive gamma iron oxide (beta radiator), since in the latter case relatively high activities have to be used in order to produce the same intracellular effects; also, artificially radioactive iron has a relatively long life (47 days half-time), so that strong sources may be dangerous. On the other hand, in the case of activation with Ra B and Ra C, no dangerous aftereffects have to be considered. One-tenth mc. of Ra B, after its complete decay, forms 2.5×10^{-6} mc. of polonium, if none is eliminated, so that even if we repeat the treatment from 10 to 20 times, we are still far below the amount of polonium formed by 0.1 µg. of Ra, the generally accepted tolerance dose.

It may, however, be even more advantageous to use, instead of Ra B–RaC, the active deposit of thorium, Th B and Th C. Th B has a longer life (10.6 hours half-time), and Th C also is the last radioactive element produced in this series, as Th D is already a stable element.

---

[3] We want to point out that this method is probably the simplest and most exact for the determination of grain sizes. Comparing it with the diffusion method, we find that we have no correction factors that may multiply any potential errors. The real surface of the powder, or grains, is simply given by the activity of the powder in comparison with that of the cooled glass tube, the surface of which can easily be measured.

In this connection it is interesting to refer to a recent paper of Kelsall (*2*), who emphasizes the relationship between lymphocytosis and cancer. If we reduce by a radiotherapeutic method the number of circulating lymphocytes, there is some hope to reduce also the growth and occurrence of tumors.

The activated gamma iron oxide (Ra B–Ra C or Th B–Th C) is interesting not only for therapeutic use but also from a biological point of view.[4] We could, for instance, follow from the outside the distribution of the activated iron oxide with a Geiger counter while trying, by means of a strong magnetic field, to influence the path of the activated magnetic cells (*1*).

Finally, using the method described by Rous (*5*) for separating Kupffer's cells by magnetic methods, the way would be open to a study of the influence of alpha particles on living cells.

References

1. Baudisch, O., and Albrecht, W. H. *Naturwiss.*, 1932, **20**, 630; Baudisch, O. *Svensk Kem. Tidsk.*, 1935, **47**, 115.
2. Kelsall, M. A. *Science*, 1945, **102**, 456.
3. Leblond, Ch. Ph., and Lacassagne, A. *Amer. J. Roentgenol. rad. Therap.*, 1943, **50**, 801.
4. Petterson, H. *Ber. IIa, Wien*, 1923, **132**, 55.
5. Rous, Peyton, and Beard, I. W. *J. exp. Med.*, 1934, **59**, 617.
6. Thewlis, L. *Phil. Mag.*, 1931, **12**, 1089; Verweg, I. W. *Z. Kristallogr.*, 1935, **91**, 65; Kordes, E. *Z. Kristallogr.*, 1935, **91**, 193; Hagg, Z. *Z. phys. Chem.*, 1935, **B29**, 95; Haul, R., and Schoon, Th. *Z. phys. Chem.*, 1939, **13**, 216.
7. Welo, L. A., and Baudisch, O. *Phys. Rev.*, 1925, **25**, 587; *Phil. Mag.*, 1925, **50**, 399; cf. *Chem. Rev.*, 1934, **15**, No. 1; and Baudisch, O. *Tekn. Samf. Handl.*, 1935, No. 4, 107; *Science*, 1923, **57**, 451; 1933, **77**, 317.

The Age Factor in Adaptability of a Sarcoma Virus to Other Animal Species

F. Duran-Reynals

Department of Bacteriology
Yale University School of Medicine

An indispensable condition for the adaptation of avian sarcoma viruses to alien species of birds is the youth of the individual in which infection is attempted, this culminating in the case of ducks, which respond to the inoculation of viruses of the Rous and Fuginami sarcomata for only 24 hours after hatching (*3, 4*). The results that follow show that the age of the chicken bearing the tumor is also a factor of importance in determining the adaptation of the virus of the Rous sarcoma to ducks.

The experiments consisted of the inoculation into the breast of newborn ducks of cell suspensions from tumors grown in chickens varying in age from 15 days to 18 months, and of analogous inoculations into successive groups of ducklings of the tumors obtained in the preceding passages at intervals of from 1 to 3 weeks. In some cases, additional ducklings were injected in the vein with tumor filtrates, and the growths ("late tumors") that evolved several months thereafter were transferred to other groups of ducklings by means of cell suspensions.

The following results were obtained:

(1) The tumors grown in chicks from 2 to 4 weeks of age were very easily transferable into ducklings in 16 out of 17 lines, each started from a different chick tumor. Growth was fast, and the hosts often died although the tumors never became generalized. Transplantation of these tumors was successful, although irregularly, for a number of passages which, however, never exceeded 6, and always in the absence of generalization. The number of ducks developing tumors became progressively smaller in the course of the passages until none of the animals responded. The tumors in the surviving birds regressed in every case, and as a result, all the lines were lost, despite the fact that a total of nearly 350 ducklings were inoculated. Despite its long sojourn in a foreign species the virus did not show detectable signs of variation, since filtrates from the duck-grown tumors produced the customary lesions at the usual rate in chicks.

(2) The tumors grown in chickens 18 months of age did poorly in ducklings for in 6 of the 8 lines started, growth followed in only 3 out of 47 birds injected, and these two tumors could not be carried beyond a second passage. However, in the two other lines growth followed in 8 of the 11 ducklings injected, and adaptation was achieved after some passages with the customary succession of events accompanying the phenomenon.

(3) The tumors grown in chickens intermediate in age between the two above groups seemed to be the most adaptable to ducks. Most of the chickens of this group were from 5 to 10 months old, while another also supplying an adaptable tumor was 3 months old. Of the 6 duck-tumor lines which have been obtained, 4 were evolved by passages of cell suspensions, while in the other 2 cases ducklings were successfully injected with both cell suspensions and filtrates, but the lines were obtained by passages of the "late" tumors induced by filtrates. To these cases one has to add at least 3 more in which filtrates induced typical "late" tumors, but neither these growths nor those produced by cell suspensions were passed into other ducks. However, adaptation was not

---

[4] An interesting paper on this topic was published by Maxfield and Mortensen (*J. appl. Phys.*, 1941, **12**, 197), who used, in experiments with rats, colloidal thorium dioxide. They found, by radioactive measurements, that six to eight hours after an intravenous injection, 99 per cent of the thorium was removed from the blood stream by the phagocytic action of the reticulo-endothelial cells. They recommend the use of this method for tests of the various theories of phagocytosis. However, using this method on man may be dangerous because of the aftereffects that are due to the long-life, daughter-product, mesothorium.

achieved with another 6 tumors grown in chickens from 5 to 8 months old.

The signs of adaptation of the chicken tumor to ducks are quite obvious: progressive growth often followed by generalization in ducks of all ages, acquisition of new tissue affinities, total or partial loss of the power to induce tumors in adult chickens, and gross and microscopic changes in the tumors (*3*). Proper analysis revealed that no two of the variants are identical, each differing from the rest in degree of generalization, incidence of non-neoplastic (hemorrhagic) or neoplastic lesions, cell type and texture of the growths, and virulence and tissue affinities of the virus inductor. In regard to the last property special mention must be made of a neurotropic strain of sarcoma which induces in the central nervous system of young ducks a typical hemorrhagic disease, while the nervous tissue of older ducks is never affected by either hemorrhagic or neoplastic lesions. Also, some of the lines have been transmitted to full-grown pigeons, in several passages, by means of cell suspensions and filtrates. Large primary tumors followed by widespread generalization have often been obtained.

The above results have to be related to the diminishing susceptibility of aging birds to tumor viruses, which finds an expression in the progressive development of a suppressing power by the blood serum against these viruses (*1, 7*). When chickens ranging in age from embryos to 2 years are infected with the virus of the Rous sarcoma, the following lesions are observed to develop: (a) a non-neoplastic, hemorrhagic disease (*2*); (b) fast-growing tumors, first combined with, and later free of, hemorrhagic lesions (*1*); (c) moderately-growing tumors (*1*); and (d) slow-growing tumors which frequently regressed (*6*). Free virus can easily be demonstrated in filtrates from hemorrhagic lesions and fast-growing tumors, whereas it is only occasionally shown in filtrates from tumors grown in old chickens (*6*). Also, study of a series of 14 spontaneous chicken sarcomata suggests that these neoplasms cannot be transplanted if they arose in old chickens (*5*).

Therefore, chicken tumor viruses infecting a progressively older individual shift from a highly favorable to a highly unfavorable medium. The present experiments suggest that adaptation to a foreign species, the duck, takes place most easily between these two extremes when presumably conditions in the medium become adverse but without reaching as yet that phase in most old animals where the effect on the virus may go as far as complete suppression and causing the tumor to regress. The process may be compared to variation in bacteria in old cultures or in convalescents. It is not that the tumor virus varies as a consequence of the infection of the duck, but rather that ducks are infected by an easily adaptable virus because that virus has previously varied in the chicken.

Finally, the fact that the tumor virus from chicks failed to vary in ducks, despite successful growth in the latter host for several passages is in itself the ideal control, proving that the lines of duck tumors were evolved by variation of the chicken virus and not by activation of hypothetical dormant duck viruses.

SUMMARY

The age of the chicken in which the Rous sarcoma is grown has an influence on the variation and subsequent adaptation of the causative virus to ducks. Adaptation is relatively easy to accomplish when the tumor has been grown in adult chickens several months of age. It has never been accomplished when the tumor has been grown in chicks and only occasionally when it has been grown in old chickens.

References

1. DURAN-REYNALS, F. *Yale J. Biol. Med.*, 1940, 13, 61.
2. DURAN-REYNALS, F. *Yale J. Biol. Med.*, 1940, 13, 77.
3. DURAN-REYNALS, F. *Cancer Res.*, 1942, 5, 343.
4. DURAN-REYNALS, F. *Cancer Res.*, 1943, 3, 569.
5. DURAN-REYNALS, F. Unpublished observations.
6. DURAN-REYNALS, F., and FREIRE, J. P. Unpublished observations.
7. KING, J. W., and DURAN-REYNALS, F. *Yale J. Biol. Med.*, 1943, 16, 53.

The Effects of Sex Hormones on the Copulatory Behavior of Senile White Rats[1]

R. S. MINNICK and C. J. WARDEN
Department of Psychology, Columbia University

S. ARIETI
Department of Neuropathology, New York State Psychiatric Institute

There is a large body of literature covering the experimental work on various aspects of sex activity. However, most of the behavioral studies are limited to the period of growth and early maturity. This is especially true of such studies as those dealing with the influence of the estrogens and androgens.

The present investigation is concerned with the effects of hormonal action on animals of relatively advanced age. Twenty-five male white rats, 28 months old, were used. The rats were very large, the average weight being 342.0 grams. They were derived from four litters and were divided into groups according to

---

[1] Thanks are due to the Schering Corporation for supplying 380 mg. of oreton (testosterone propionate) and 450 Cartland Nelson units of anteron (pituitary-like hormone from pregnant mares' serum). Thanks are also due to Parke Davis and Company for supplying 100,000 I.U. of the estrogen compound, theelin.

the split-litter technique. The 25 animals were arranged into three groups, as indicated in Table 1. A well-balanced diet was supplied, consisting of Purina products (Growena mash, Dog Chow pellets) and a plentiful supply of fresh lettuce. Each animal in the testosterone group was given daily subcutaneous injections of 1.25 mg. of the hormone in sesame oil for a period of 15 days. Each animal of the anteron group was give 5 Cartland Nelson units in tricresol solution every third day for a like period, or 25 units in all. The animals in the control group were given either sesame oil or tricresol solution, in amounts equal to the dosage allotted to the two experimental groups. Since the nature of the control injection had no effect on copulatory behavior, the control group will be considered as a unit.

TABLE 1

COPULATION SCORES FOR THE THREE GROUPS, ON THE 8TH AND 15TH DAYS

Control Group			Testosterone Group			Anteron Group		
Rat No.	8th day	15th day	Rat No.	8th day	15th day	Rat No.	8th day	15th day
1	0	7	9	14	21	17	18	17
2	0	0	10	11	17	18	13	17
3	0	0	11	11	15	19	10	18
4	0	0	12	9	17	20	8	13
5	0	0	13	4	15	21	6	7
6	0	0	14	0	14	22	4	11
7	2	0	15	0	0	23	4	7
8	3	0	16	0	0	24	0	0
						25	0	0
Av.	0.625	0.875		6.125	11.625		7.00	10.00

In the copulatory tests, each rat was exposed individually to a female in heat for a period of 10 minutes. These tests were conducted between 11: 00 P.M. and 2: 00 A.M., with low illumination, to ensure maximum activity. Females, as incentive animals, were kept continually in heat by giving them daily subcutaneous injections of 666 I.U. of estrogen compound (theelin). A strict criterion of copulatory activity was employed. This required that the usual pattern of rapid lumbosacral anterior-posterior oscillations, followed by licking of the penis, occur in each instance.

The main results for both copulation tests are shown in Table 1. As will be seen, only three animals of the control group exhibited copulatory behavior, and each of these only on one or another of the tests. The two experimental groups gave a fairly high average copulation score, although two of the animals of each group did not copulate at all. The difference between each of the two experimental groups and the control group is statistically significant, whereas the difference between the two experimental groups is not.

It is clear from these results that rather large doses of testosterone propionate are no more effective than the pituitary-like hormone as here employed. In the case of the latter, we must assume that the hormone operated as an activator on the interstitial cells of the testes. This interpretation seems necessary, in spite of the fact that anteron is regarded as primarily an activator for spermatogenic functions. This view is also supported by the histological findings that the interstitial cells of this group showed hypertrophy and hyperplasia in most cases. The testosterone group, on the other hand, showed some degree of atrophy at the various stages of spermatogenesis as well as atrophy of the interstitial cells with replacement fibrosis. These results would seem to raise a question as to the advisability of using testosterone propionate in replacement therapy, as is common in clinical practice. A more detailed account of this experiment may be found in another connection (*1*).

Reference

1. MINNICK, R. S. The effects of injecting testosterone propionate and gonadotropic hormones on the copulatory behavior of senile white rates. Master's thesis, Columbia Univ., 1942.

Scanning Science—

Near the beginning of last year, a discovery was made that excited great interest throughout the scientific world, when it was announced that remains of a veritable missing link between man and the higher apes had been found in Java, in strata of Pleistocene age. The discovery was made by Dr. Eugene Dubois, a surgeon in the Dutch army, who had been stationed in Java for several years and had devoted much time to the vertebrate fossils of that island. . . .

The facts relating to the discovery itself and the position in which the remains were found, as stated by Dubois in his paper, together with some additional details given to me personally, convinced me that, in all probability, the various remains attributed to *Pithecanthropus* pertained to one individual. Under the circumstances, no paleontologist who has had experience in collecting vertebrate fossils would hesitate to place them together. . . .

The tooth, skull and femur, were found at different times in the same horizon, all imbedded in the same volcanic tufa. The tooth was found first, in September, 1891, about a meter below the water level during the dry season, and 12 or 15 meters below the plain in which the river had cut its bed. A month later, the skull was discovered, only a meter distant from the place where the tooth lay. In August, 1892, the femur also was found, about 15 meters distant from the locality where the other specimens were imbedded. Later, in October of the same year, a second molar was obtained at a distance of not more than three meters from where the skull-cap was found, and in the direction of the place where the femur was dug out. . . .—O. C. Marsh

—29 May 1896

Obituary

Forrest Rhinehart Immer

1899-1946

Forrest Rhinehart Immer, associate director of the Minnesota Experiment Station and professor of agronomy and plant genetics at the University of Minnesota, died suddenly on 2 February 1946 as a result of a heart attack.

Dr. Immer was born at Spencer, Iowa, on 18 July 1899. While a small boy, he moved with his family to a farm near Jeffers, Minnesota. After graduation from high school in 1917, he entered the service for a few months during World War I. He then entered the University of Minnesota and received his B.S. degree in 1924, his M.S. degree in 1925, and his Ph.D. in 1927.

Dr. Immer served as instructor of plant genetics in the University of Minnesota from 1927 to 1929 and as assistant plant geneticist during 1929–30. He then became associate geneticist with the Division of Sugar Plant Investigations of the U. S. Department of Agriculture, serving in this capacity from 1930 to 1935, with headquarters in the Division of Agronomy and Plant Genetics of the Minnesota Agricultural Experiment Station. During this same period he acted as adviser in statistics in the Experiment Station. Soon after accepting this position he was appointed a Fellow of the National Research Council for the year 1930–31 and spent this time in England and Sweden, studying statistics at the Rothamsted Experiment Station, England, under the direction of R. A. Fisher, and plant breeding at the Svalöf Plant Breeding Station, Sweden. In 1935 he rejoined the University of Minnesota as associate professor in the Division of Agronomy and Plant Genetics and occupied this position until 1937, when he was made a full professor. In addition to his duties as professor of agronomy and plant genetics, he was appointed vice-director of the Minnesota Experiment Station in 1941 and became associate director in 1942, in which capacity he served until his death.

One of Dr. Immer's major contributions to science was as a joint author with H. K. Hayes of a book entitled *Methods of plant breeding*, published in 1942.

Another of Dr. Immer's chief contributions was through his students. In recent years, with his added administrative duties, he continued to teach a course in Applied Statistics. His enthusiasm in science and especially in genetics and applied statistics, his fund of information in many fields, and his ever-readiness to help his students attracted an increasing number of students to his classes and made him an inspiring teacher.

Dr. Immer was called for special duty in England, in 1944, as operations analyst with the Eighth Air Force. Here he was assigned to the Operations Analysis Section, whose duty it was to analyze bombing operations and improve bombing accuracy. For his exemplary service he received citations from Gen. H. H. Arnold and Lt. Gen. J. H. Doolittle.

Dr. Immer returned to his position at the University of Minnesota in November 1944. In his administrative position he was rapidly gaining recognition and assuming leadership in the solution of agricultural problems and was serving as chairman of the Committee on Farm Structures and on Poultry Breeding set up by the directors of the North Central Regional Experiment Stations. He was also chairman of a committee on legislation relating to farm structures for the Association of Land Grant Colleges. He was very active in the American Society of Agronomy, serving on various committees, and was consulting editor in statistics for the journal at the time of his death.

H. K. Hayes

Division of Agronomy and Plant Genetics
University of Minnesota

Homer Jay Wheeler

1861-1945

Homer Jay Wheeler died on 18 November 1945 in the Mountainside Hospital, Montclair, New Jersey. He was born to Quakers, Jesse B. and Martha (Sykes) Wheeler, in Bolton, Massachusetts, on 2 September 1861.

Upon graduation from Massachusetts Agricultural College in 1883, Wheeler was offered a position as assistant to Dr. Goessmann, who had just been made director of the newly established Massachusetts Agricultural Experiment Station. He accepted the offer and served the Station for four years, thus gaining the unique distinction of having actually performed the first chemical analytical work done there.

Through the influence of Dr. Goessmann, and the generosity and confidence of a friend who loaned him sufficient funds to make the venture possible, he departed from New York for Germany in the summer of 1887 to study for his Ph.D. degree at the University of Goettingen. During his two years at the University he studied under Profs. Victor Meyer, Tollens, Henneberg, and Von Koenen. While there, together with a small group of American students, he heard the first lectures ever given on "The Operation of the Respiration Calorimeter" (Dr. Pfeiffer). Upon being awarded the M.A. and Ph.D. degrees in 1889 he returned to the United States to assume the duties of chief chemist of the newly established Rhode Island Agricultural Experiment Station at Kingston, Rhode Island. On 15 May 1891 he was married in Brooklyn, New York, to Frieda H. F. Ruprecht of Goettingen, Germany.

It was not long before his work in connection with soil acidity, and particularly in pointing out the occurrence of an injurious degree of acidity even in many well-drained upland soils in this country, began to gain him not only national but also international recognition. Concurrently he worked on the effect of soil acidity in lessening the danger from potato scab, on the fertilizing value of sodium salts for certain crops, especially where there was a deficiency of potash, and on many similar agricultural problems. Not long after his arrival at the Rhode Island Agricultural Experiment Station he was offered the position of professor of geology in the State College, which position he filled concurrently with his Experiment Station work from 1894 to 1912. During the period from 1902 to 1903 he served similarly as professor of agricultural chemistry and from 1902 to 1912 as professor of agronomy. In 1902 he accepted the directorship of the Experiment Station and held this position until 1912, when he resigned to become manager of the Agricultural Service Bureau of the American Agricultural Chemical Company. In the interim he had made a visit to Europe to study work being done there; he had served in 1902 and 1903 as acting president of the Rhode Island State College; he was author and co-author of a great many bulletins and reports issued by the Station; he was author of the book, *Manures and fertilizers* (Macmillan); he had served as president of the Association of Official Agricultural Chemists of the United States, as president of the American Society of Agronomy, and as chairman of the New England Section of the American Chemical Society. In 1912 Brown University conferred upon him the honorary degree of Sc.D.

During his first 16 years with the American Agricultural Chemical Company, Dr. Wheeler was located in Boston. In 1928 he was transferred to the new headquarters in New York City. While manager of the Agricultural Service Bureau, he wrote and had published many bulletins, booklets, and circulars on various agricultural subjects; he conducted experiments with fertilizers in practically all of the eastern states from Maine to Florida, and as far West as the Upper Michigan Peninsula, Wisconsin, and Minnesota. He also conducted experiments with radioactive substances, with manganese, boron, and such other elements as had been claimed or purported to be beneficial to plant growth. During World War I he served as chairman of the Committee on Soils and Fertilizers of the National Research Council.

In 1933 his Alma Mater conferred upon him the honorary degree of Sc.D.

Up to five weeks before his death, Dr. Wheeler maintained a keen and active interest in all fields of chemical development and particularly in the field of agricultural chemistry. His interest in research dated from the time when in Germany he produced the first wood sugar, xylose, from beech wood, and jute.

CARL O. J. WHEELER

25 Outlook Place, Glen Ridge, New Jersey

News and Notes

The American Physical Society held its 272nd meeting at the University of Chicago 20–22 June. Two other meetings are scheduled for the summer months, one at the University of California at Berkeley, 12–13 July, and the other in New York City 19–21 September.

Some confusion surrounded the early plans of the meeting because security releases were slow in coming; nevertheless 97 papers were read during the three days in addition to the longer lectures prepared by invitation.

On Thursday morning there were three such lectures scheduled, E. U. Condon, president of the Society, presiding. E. Fermi spoke on "Elementary Pile Theory," R. F. Christy on "The Small Enriched Reactor at Los Alamos," Gregory Breit on "Theory of Nuclear Reactions."

L. A. DuBridge, vice president of the Society and president-elect of the California Institute of Technology, presided in the afternoon session which heard Farrington Daniels on "Problems and Plans of Nucleonics Research," J. R. Dunning on "Neutron Spectroscopy," and H. H. Goldsmith on "A Critical Survey of Neutron Cross Sections."

At the dinner session on Thursday night A. H. Compton spoke on "Physics Research and Release of Nuclear Energy."

Saturday, G. T. Seaborg described the "Transuranium Elements" while E. P. Wigner, Princeton, lectured on "Introduction to Theoretical Papers from Clinton."

On 4 June Rep. Emanuel Celler, New York, introduced a bill into the House calling for the establishment of a National Science Foundation. This bill, H.R. 6672, is the companion legislation to S. 1850. It has been referred to the Subcommittee on Public Health of the Interstate and Foreign Commerce Committee, which still has H.R. 6448. Since S. 1850 is awaiting passage by the Senate, the contest is now between H.R. 6448 and the new bill, H.R. 6672.

About People

Richard C. Darnell, consulting engineer on instrument design and application and president of the Washington Instrument Society, has been appointed by the Department of State, under its cultural cooperation program, to serve in China as a specialist in scientific instruments and laboratory equipment. Mr. Darnell will assist in the selection of modern scientific instruments needed to replace those worn out or looted from universities and research organizations.

John A. Fleming, who retires on 30 June as director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, will be temporarily located at the Carnegie Institution's Office of Administration, 1530 P Street, N. W., Washington 5, D. C., as adviser to the Institution in governmental and international scientific relations. As announced in *Science* on 12 April, Merle A. Tuve becomes the new head of the Department on 1 July.

Robert S. Harris, director of the Nutritional Biochemistry Laboratories at Massachusetts Institute of Technology, has been promoted to professor of biochemistry of nutrition in the Department of Food Technology.

Forrest F. Cleveland, professor of physics and director of spectroscopy research at Illinois Institute of Technology, Chicago, will return on 1 July to his former position as head of the Departments of Physics and Mathematics at Lynchburg College, Virginia.

Felix G. Gustafson, professor of botany, University of Michigan, has been invited by the Ministry of Agriculture of Brazil to give a lecture course in plant physiology in the Graduate School at the Universidade Rural, Rio de Janeiro, during the months July to September. He will also give a few lectures on recent researches in plant physiology.

A. C. Trowbridge, state geologist of Iowa and head of the Department of Geology at the State University of Iowa, and L. L. Ray, geologist with the U. S. Geological Survey, will attend an excursion to central Norway in late June and early July. The excursion, under the auspices of the Norsk Geologisk Forening, will examine phenomena connected with the retreat of the last ice sheet, and geomorphology. K. M. Strøm is the leader of the excursion.

Lt. Col. Gustave J. Dammin, Medical Corps, in June leaves the Office of The Surgeon General, where he has been chief of the Laboratories Branch since January 1945 to join the staff of the Department of Pathology at The Johns Hopkins Medical School. Col. Dammin was awarded the Legion of Merit for his work in the Laboratories Branch and as a member of the Dysentery Commission in India, and has recently returned from Europe, where he was a member of the Influenza Mission.

Alexander Silverman, head of the Department of Chemistry of the University of Pittsburgh, addressed the Western Maryland Section of the American Chemical Society in Cumberland, 24 May, on "Glass: Retrospect and Prospect."

Erwin Raisz, of the Institute of Geographical Exploration, Harvard University, gave the annual lecture on 18 May before the University of Cincinnati Chapter of Sigma Xi, speaking on "Maps: Their Past, Present, and Future."

Luther S. West, chief of Natural Sciences and head of the Department of Biology, Northern Michigan College of Education, Marquette, has been awarded the Army Commendation Ribbon for his work in entomology in the Army Medical School.

Croom Beatty, III, has resigned as director of the Organic Research Laboratory of the Sprague Electric Company, effective 1 July 1946, to accept an appointment as assistant professor of chemistry at Purdue University, West Lafayette, Indiana.

Perry J. Melnick has been appointed associate professor of pathology at the University of Southern California Medical School. Dr. Melnick was released from active duty as a lieutenant colonel in the Medical Corps in April.

Announcements

The Air Surgeon announces the development of a hydraulic artificial leg at the Army Air Forces Aero Medical Laboratory in Heidelberg, Germany. Two German scientists, Ulrich K. Henschke and Hans A. Mauch, working in this Laboratory, have invented a device consisting of a small cylinder filled with hydraulic fluid and a piston connected with the upper leg. The movement of the piston is controlled by a valve which can be opened or closed at will with the abdominal muscles, by means of an ingenious belt.

The hydraulic element can be installed in present artificial legs.

Principal advantages are the control of knee flexion and the ability to lock the knee in various degrees of flexion; these are considered to be considerable advances in prostheses. The development will shortly be turned over to Surgeon General Kirk and his Research Protheses Laboratory for further exploitation.

The Physics Department of the University of California, Los Angeles, announces the following promotions in rank and new appointments: L. P. Delsasso and Norman A. Watson have been promoted to associate professorships. J. R. Richardson has been appointed associate professor, and Byron Wright and Bernard Peters have been appointed assistant professors. The last three men will be responsible for the inauguration of a program in nuclear physics. The original 37-inch cyclotron is to be transferred from Berkeley to the Los Angeles campus and will be operated as a frequency modulated cyclotron.

The sentence imposed upon Alan Nunn May by the British Government has been strongly criticized by the Executive Committee of the Association of Scientific Workers of Great Britain in a communication directed to the American Association of Scientific Workers in the United States. The British Association does not seek to justify Dr. May's breach of the Official Secrets Act, but feels that the sentence of 10 years penal servitude is out of proportion to the offense in view of the following facts: The maximum sentence in the proposed British Atomic Energy Bill is only five years penal servitude; less severe sentences have been imposed upon persons who had actively aided the enemy; the person to whom Dr. May gave unauthorized information was a representative of an allied government; little consideration seems to have been taken of Dr. May's positive contribution to atomic bomb research; Dr. May was in a position to give fundamental scientific information only, having had no connection with the "know-how" of atomic bomb manufacture.

The Association believes that full freedom in the interchange of scientific knowledge is essential both for scientific progress and international cooperation. The report also expresses the opinion that the original decision to undertake the development of atomic energy without the closest cooperation with the Soviet Union was a hindrance to, and has largely contributed to the present unfortunate situation in, international relations.

Two fellowships for the study of rheumatic fever are available to recognized institutions concerned with the study of rheumatic fever and rheumatic heart disease, according to the American Council on Rheumatic Fever of the American Heart Association. Each fellowship is for a period of three years and carries a stipend of $3,500, $4,000, and $5,000 for the first, second, and third years, respectively.

These fellowships are provided by the American Legion and its Women's Auxiliary as part of their program of fostering research in rheumatic fever and rheumatic heart disease.

Applications supplying information concerning the institution, the projected study, and the individual proposed for the fellowship will be accepted until 1 August, to be effective 1 September, and should be addressed to the American Council on Rheumatic Fever, American Heart Association, 1790 Broadway, New York 19, New York.

The National Mental Health Act, the Priest Bill (S. 1160 and H.R. 4512), has been endorsed by the Public Health Relations Committee of the New York Academy of Medicine, on behalf of the Academy. This measure provides for the establishment of a national psychiatric institute and allocates the sum of $10,000,000 per annum to provide grants-in-aid to universities, hospitals, laboratories, and other public institutions and to individuals for research projects in the field of psychiatry.

The Committee has expressed the view that the studies should be directed toward the early detection of these disturbances, their prevention, and a more practical and shorter form of therapy. The opinion was also expressed that the institution should be placed near an urban center within easy reach of clinical material and interchange with other scientific organizations. The Academy feels that too great a size and too rapid a turnover will preclude a careful follow-up system among in-patients. It was also recommended that the compensation should be adequate enough and the selection and training of personnel scrupulous enough to achieve the highest degree of competence on the staff of the institution. It is further hoped that the program will encourage more adequate psychiatric training within the medical schools.

The Van Eseltine collection of Carex has been transferred from Keuka College, New York, to Cornell University. Started in 1913 while the late Glen Van Eseltine was at the Smithsonian Institution, this collection grew to nearly 1,400 sheets over a period of 25 years. In 1938 the Van Eseltine herbarium of about 5,000 specimens, all carefully preserved, mounted, and labeled, was presented to Keuka College. Since it was felt that the Carex genus was not of sufficient interest to students in a small college, arrangements were made to transfer it to Cornell University, where it could be put to fuller use. The remainder of the herbarium is retained at Keuka College.—*Hazel R. Ellis* (Keuka College).

Recent Deaths

John C. Hoyt, 72, died 21 June at his summer home at Paris, Virginia. He had been a member of the U. S. Geological Survey for twenty years and in government service for 49 years prior to his retirement in 1944.

Philippe Lasseur, 63, professor of microbiology in the Faculté de Pharmacie, Université de Nancy, died on 10 January 1946 from complications following an attack of pneumonia. Dr. Lasseur is best known for his studies on the conditions affecting growth and pigment production by dissociated types of various species of chromogenic bacteria. In 1928 he founded the annual publication, *Travaux du laboratoire de microbiology de la faculté de pharmacie de Nancy*, in which most of his later work was published. Despite the difficulties of the war, he was able to continue work and the publication of this journal, of which Fascicule 14 appeared in 1945.

Harry Waldo Norris, 83, professor emeritus of zoology at Grinnell College, Iowa, died on 15 January.

Hellen Elisabeth Ramsdell (Mrs. Noel F. Shambaugh), formerly on the faculties of Ohio State University and the University of Michigan, died at Signal Hill, California, on 23 January.

E. G. Boulenger, 57, director of the Zoological Society (London) aquarium from 1923 to 1943, died on 30 April.

The War and Biological Sciences in Japan[1]

Before the war, Japan was ahead of other Oriental countries in most fields in extent of scientific development. In the years immediately preceding the war there was a definite trend toward publishing scientific works in the Japanese language, and many finely illustrated books or comprehensive works appeared, particularly those dealing with the fauna and flora of Japan or neighboring countries.

The biological sciences have suffered considerably in Japan as a result of the war. In general, only research of importance to the war effort was given support; nevertheless, university professors and certain scientists had some freedom, within the limitations of equipment, materials, and demands made upon their services. As a result of the confusion incident to the bombing of the Japanese homeland in the latter part of the war, much of the nonessential work virtually came to a standstill, and at the present time emphasis is being placed on increasing production of food, particularly that coming from marine and agricultural sources.

Considering the extent to which most of the cities of Japan were destroyed, a fairly high proportion of the scientific institutions received little or no damage. The Imperial University, with its branches at Tokyo, Sendai, Sapporo, Nagoya, Kyoto, Osaka, Fukuoka, Keijo, and Taihoku, lost very few buildings. None were lost in Kyoto, Sapporo, Fukuoka, Keijo, and Taihoku; only a few wooden buildings and dormitories were burned at Tokyo; and a few structures were destroyed at Sendai and Osaka. The biological laboratories and collections are still almost entirely intact.

In Tokyo, the Agriculture College, the Science College, and the Research Institute of Natural Resources were almost completely destroyed by fire, including laboratories and collections. The Imperial Agriculture Experiment Station remains intact, as do the Higher School of Agriculture and Forestry, the Sericulture Experiment Station, and the Forestry Experiment Station. Of the private ornithological museums in Tokyo, that of Marquis Yamashina is the only one still intact. Prince Takatsukasa's museum was completely destroyed. The collection of Mr. Hachisuka (formerly Marquess) is partly stored at Marquis Yamashina's museum. Marquis Kuroda's collections of birds and mammals were completely destroyed. Viscount Shibusawa's fish and anthropological collections are intact. The private entomological museums belonging to S. Hirayama and M. Kato were not destroyed, although they have been closed for many months. The Ueno Museum was likewise untouched.

Institutions in Kyoto are intact, as is the Hydrobiological Station of Kyoto Imperial University at Otsu, on Lake Biwa. In Hiroshima, the Science College and College of Agriculture and Forestry were destroyed, as was the Medical College in Nagasaki. The Marine Biological Station at Misaki was taken over and its work interrupted by the Japanese Navy. The marine stations at Asamushi (Mutsu Bay, near Aomori) and Shimoda are operating, as is the laboratory of the Nissan Marine Products Company at

---

[1] The ideas set forth in this article are those of the author and are not necessarily endorsed by the Navy Department. The information was collected by the undersigned while serving on the staff of the Commander, U. S. Fifth Fleet as assistant to Commodore M. D. Willcutts, MC, USN, Fleet Surgeon.

Odawara. Parts of the collections or libraries of many of the institutions which were not destroyed are still displaced, having been moved out of the cities as precaution against destruction.

Relatively few scientists were among the many thousands of civilians killed during the war. In Hiroshimo, however, many members of the staff of the Science College were killed, including Prof. Hiraiwa and Asst. Prof. I. Sato, of the Zoology Department. In Nagasaki, the president, 12 of the 19 professors, 10 assistant professors, and others of the Medical College were killed.

Among the scientists who died natural deaths during the war was Asajiro Oka, who was a student of Leuckart, and introduced the theory of evolution into Japan. He was professor at Tokyo Higher Normal School and Tokyo Science College. Dr. Oka's death occurred on 2 May 1944. His son, Hidemichi Oka, is now experimental zoologist at Tokyo Science College and editor of the Zoological Magazine (*Dobutsugaku Zasshi*). Chiyomatsu Ishikawa died in Formosa in 1941 or 1942. Dr. Sasaki, of the College of Agriculture, Tokyo Imperial University, died shortly before the start of the Pacific War. Matsuji Hori and Y. Niijima, of Sapporo, and Masaki Matsushita, of Toyohara, Hokkaido, all of whom were entomologists, died during the war.

Among the specialists displaced by the war may be mentioned the following, with their respective locations at the end of the war: Ryoichi Takahashi, aphid specialist of Formosa: head of the zoological gardens, Kuala Lumpur, Malacca; Seishun Iwata, mosquito specialist of Osaka Imperial University Medical College: Kuala Lumpur; Kinji Iwanishi, mayfly specialist of the Otsu Hydrobiological Laboratory: Mongolia; Mr. Dokei and S. Kawada, entomologists of the Imperial Agriculture Experiment Station: China and Java, respectively; Isao Taki, malacologist: in charge of mollusc collections of the Academia Sinica, Nanking; Y. Yano, professional collector: Burma; H. Sawada, coleopterist: China; Kunio Iwata, hymenopterist: Hainan Island; Maj. Shinichiro Yamada, mosquito specialist, and Atsuo Tanaka, specialist in biting flies, of Kyoto Imperial University: Japanese Army, locations unknown. S. Hatai, zoologist of Sendai Imperial University, went to Manila to work at the Bureau of Science for the Japanese Army, but returned to retirement at Omori, in Tokyo, before the recapture of Manila. His son, Naoki Hatai, zoologist, was in Peking at the end of the war. Another son, Kotora Hatai, is still at Sendai Imperial University, working on fossil invertebrates. The Palau Tropical Biological Station was moved with its staff to Makassar, Celebes, and many other specialists were scattered in the "southern regions."

Some of the principal Japanese specialists are at present located as follows:

Tokyo Imperial University—N. Yatsu (retired), zoology; Y. K. Okada, experimental morphology; T. Goda, biochemistry; T. Kamada, physiology; K. Dan, embryology; K. Takewaki, internal secretions; H. Kinoshita, physiology; T. Fujii, biochemistry; K. Kikuchi, limnology (also of the Marine Biological Station, Misaki); Y. Shinoto (Sinoto), N. Tanaka, and N. Suita, plant genetics; T. Kaburaki and T. Kojima, entomology. *Botanical Gardens, Koishikawa, Tokyo*—Haruo Furukawa. *Research Institute of Natural Resources (Shigenkagaku Kenkyusho)*, with several temporary locations in Tokyo and a laboratory near Mt. Fuji—Yaichiro Okada, vertebrate zoology (also curator of Marquis Yamashina's museum); Kiyomatsu Matsubara and Mr. Kuronuma, ichthyology; and Kenichi Nomura, entomology. *Imperial Agriculture Experiment Station, Tokyo*—Hiroshi Terao, director; Hiroharu Yuasa, Coleoptera, chief entomologist (S. Kinoshita has retired and is now insecticide specialist for a chemical firm in Saitama Prefecture); Nobumasa Yagi, flies; Masahiro Ii (Tozawa), T. Kawabe, T. Yamazaki, and Mr. Kamito, agricultural insects. *Tokyo Agriculture College*—K. Kamiya and T. Adachi, Coleoptera. *Higher School of Agriculture and Forestry*—Dr. Tei Ishii, parasitic Hymenoptera, and O. S. Shinji, aphids and gall insects. *Imperial Sericulture Experiment Station*—Juichi Kuwana (son of the late S. I. Kuwana), entomology.

Sendai Imperial University—Sanji Hozawa, termites and calcareous sponges; K. Mashiko, limnology and mosquitoes; S. Nomura, physiology; I. Motomura, experimental zoology, chairman, Biological Institute; Drs. Yamaguchi and Yoshii, botany; Dr. Tahara, plant cytology; Y. Satake, dean of the Medical College. *Agriculture Experiment Station, Omaguri, Akita*—Mutsuo Kato, entomology. *Sapporo Imperial University*—Tokuichi Uchida, parasitic Hymenoptera, head of Entomology Department (Shonen Matsumura, retired, is living in Tokyo); S. Watanabe, parasitic Hymenoptera; Hiromichi Kono, retired, Coleoptera; Kan Oguma, scale insects; Toru Uchida, coelenterates, head of Zoology Department; T. Inukai, mammalian embryology. *Kamakura Normal School*—T. Sakai (formerly of Shimoda Marine Biological Station), crabs. *Nissan Fisheries Company Laboratory*—Toshio Kumada, ichthyology.

Kyoto Imperial University—Taku Komai, genetics, head of Zoological Institute; M. Chino, genetics; T. Kawamura, birds; Prof. Miyaji, limnology; I. Honjo, physiology of senses of gnats and fleas; G. Nakada, mosquitoes; S. Yamaguchi, parasitology; Chukichi Harukawa (formerly of Ohara Agriculture Experiment Station), agricultural insects; Shunro Uchida, pea weevils and other pests; Yasuji Yamada, insects attacking wool; Dr. Kimura, bacteriology; Dr. Yamori, radiology; Dr. Ozawa, pathology. *Otsu Hydrobiological Laboratory, Kyoto Imperial University*—Prof. Miyaji, T. Kawamura; Matsuzo Ueno, aquatic flies; Masunae Tsuda, caddisflies; Mr. Uchinomi (Utinomi), invertebrates; Satojiro Kawamura, embryology; M. Hiraguchi, anatomy; K. Yamamoto, plankton. *Kyoto City Medical College*—Shiro Kitakami and Chuai Mineura, medical flies. *Doshisha University, Kyoto*—Motoichiro Maki, herpetology. *Temporarily unemployed*—M. Tokunaga, nematocerous flies. *Private entomological museum, Yamashina, Kyoto*—Kichizo Takeuchi, sawflies. *Private entomologist, Takarazuka, Osaka*—Nobuyoshi Tozawa. *Kyushu Imperial University, Fukuoka*—Teizo Esaki, Hemiptera, head of Entomology Department; K. Yasumatsu, Hymenoptera; H. Oshima, echinoderms; K. Uchida, young marine fishes; H. Aikawa, marine crustaceans, head of Zoology Department; Dr. Narabayashi, head doctor of University Hospital. *Nagasaki Medical College*—K. Koyano, acting president.

Taihoku Imperial University, Formosa—T. Shiraki, entomologist, retired 1944; S. Isshiki, neuropteroids, head of Entomology Department; Y. Miwa and M. Chujo, Coleoptera; K. Koidzumi, insect physiology; Mr. Maki, insect morphology; Toyohi Okada, flies; Kaoru Morishita, mosquitoes; G. Masamune, plant taxonomy; S. Hibino, plant physiology. *Forestry Bureau, Taihoku*—T. Mitono, Coleoptera. *Institute for Research in Tropical Medicine*—N. Omori, mosquitoes. *Keijo Imperial University, Korea*—Harujiro Kobayashi, medical flies; K. Hori, flies.

Publication of scientific reports was greatly reduced during the war. Journals of institutions were reduced in size, and many society or private publications had been discontinued by 1943 or early 1944. Many of the books published during the war are on rather poor paper. A number of popular or semipopular scientific books were published, but few well-illustrated, high-quality texts or works on fauna or flora appeared. In general, few technical or taxonomic reports on the "southern regions" appeared, though many investigations were initiated.

Among works which appeared during or just before the war were the following: Utinomi (Uchinomi): *Bibliographica Micronesica*; Research Institute of Natural Resources: Bibliographies, covering most scientific fields of China, the Philippines, the East Indies, Indo-China, and South Pacific Islands; M. Tokunaga: *Medical entomology*, two large volumes in Japanese, well illustrated, with some color plates (1944); T. Kumada (Nissan Fisheries Company Institute): *Edible marine life of the South Pacific*, with 149 color plates, good printing, Japanese text (1941); and *Poisonous fish of the South Pacific*, with 29 plates, 27 of them in color, good quality, Japanese text (1943); Orihei S. Shinji: *Monograph of Japanese Aphididae*, 1215 pages, 579 text figures, 8 color plates, in Japanese (Tokyo, 1941); and *Galls and gall insects*, published in Tokyo by Shunyodo, with many photographic plates of poor quality, in Japanese (1944); G. Masamune: *Flora Kainantensis* (Flora of Hainan Island), (Taihoku, 1943); Umetaro Suzuki and Shizuo Momose: *Illustrated economic botany of the ''southern regions,''* 193 pages, 43 plates, in Japanese (Tokyo, 1943); Hachisuka: *Birds of Hainan Island*, in English (Tori, Tokyo, 1940); Ryoichi Naito and Ryoen Kono: *Eradication of malaria-carrying mosquitoes*, 176 pages, illustrated, in Japanese (Hokuryukan, Tokyo, 1944). In 1939 Kaoru Morishita published an 82-page pamphlet, in Japanese, on Chinese *Anopheles* at Taihoku under the auspices of the Hakuaikai Hospital at Amoy, China. In 1941 Nanzaburo Omori, of the Institute for Research in Tropical Medicine, Taihoku, published an article in Japanese on the *Anopheles* of the ''southern regions.'' In 1942 Toyohi Okada, of the Institute of Hygiene, Taihoku Imperial University, published on helcid flies in the *Transactions of the Natural History Society of Formosa*. Between 1940 and 1943 Seishun Iwata, of Osaka Imperial University Medical College, published a number of articles and pamphlets on mosquitoes, malaria, and dengue, dealing mostly with breeding habits and control of disease vectors. All are in Japanese. Yushiro Miwa published a *List of injurious insects of Formosa*. Among semipopular works recently published are: Yaichiro Okada's *Southern biology*, Furukawa's *Southern zoology*, Tamanuki's *Natural history of Saghalien*, Kunio Iwata's *Wasp stories*, Yaichiro Okada, T. Kaburaki, and others' *Natural habitats of animals*, and Yoshio Takeuchi's *Bamboos* (1940). A set of large color plates of *Birds of Greater East Asia* was published in four series, each series consisting of 5 to 6 plates which showed 8 to 12 species of birds. Among books completely destroyed in the press was Yaichiro Okada's *Freshwater fishes of Japan*, with 33 color plates.

Among more recent serial publications are Yushiro Miwa and Michio Chujo's *Catalogus Coleopterorum Japonicorum; Scientific results of the first expedition to Manchoukuo*, of which 18 volumes have already been published; and *Nihon Dobutsu Bunrui* (taxonomy of Japanese animals), of which many parts have appeared, some during the war. The newer periodicals include the *Transactions, Journal,* and *Bulletin*, all or part in English, as well as two serials in Japanese of the Research Institute of Natural Resources; *Oyokonchugaku Zasshi* (magazine of applied entomology), published at the Imperial Agriculture Experiment Station, in Japanese; *Mushi no Sekai* (the insects' world) published by S. Hirayama, Tokyo, in Japanese; and *Nippon no Kōchu* (Japanese Coleoptera), published by Kazuo Kamiya, of the Tokyo Agriculture College, largely in Japanese. Some older periodicals are *Tenthrèdo, Acta Entomologica*, in English, published by Kichizo Takeuchi, of Kyoto; *Mushi* (insects), published in various languages at Kyushu Imperial University; *The Entomological World*, mostly in Japanese, published by Masayo Kato, of Tokyo.

In scientific development and discoveries Japan, during the war, was behind the United States in many ways, although some new drugs were developed which may prove valuable. Among these are two neocyanines, called *kōha* and *shikō*, which are reputed to be helpful in the treatment of leprosy, tuberculosis, wounds, and burns. The formulas for these are given as 1,1,1″-triethyl-10-lepidyl-1-4, 4′-trimethinequinocyanine-1,1″-diiodide and 3,3′,3″,4,4′,4″-hexamethyl-

7-2′-methylthiazolyl-2,2,-trimethine-thiazolocyanine-3,-3″-diiodide, respectively. Until the end of the war, "DDT" was known to Japanese scientists only by name. As soon as the atomic bombs were dropped on Hiroshima and Nagasaki, pathologists and other specialists were sent to the areas from various institutions, particularly Kyoto and Kyushu Imperial Universities, to study effects on the victims. Many necropsies were performed and specimens taken, and, before American personnel arrived, it had been concluded that hypoplastic anemia was the principal cause of deaths occurring some time after the explosions in the case of victims who did not have serious radium burns. It was also concluded that radioactivity in the areas disappeared within several days, although people entering the areas shortly after the explosions became anemic.

In general, Japanese scientists and most of the population show a great desire to develop contacts and friendly relationships with America and to increase American influence in Japan. This attitude is not as naïve as might be assumed by one not realizing the extent to which most of the Japanese people were ignorant of the actual facts about the war and how resentful they now are of the Japanese militarists who forced the country into conflict.—*J. Linsley Gressitt*, Lt. (jg), H(S), USNR (U. S. Naval Medical Research Unit No. 2, Guam, Marianas Islands).

In the Laboratory

A Useful Selective Bactericidal Property of Tergitol-7

Arthur L. Pollard
Knoxville, Tennessee

In the course of isolating Streptomyces (Actinomyces) from soil on starch tryptone agar an extremely heat-resistant bacillus was found as a contaminant in the starch used. Only an Arnold sterilizer was conveniently available, and frequently this organism would remain viable after heating for 30 minutes on three successive days. In one case it remained viable after heating for 30 minutes on six successive days.

The work of Baker, Harrison, and Miller (*1*) suggested detergents as a possible means of eliminating the bacillus without inhibiting the growth of Streptomyces. After some preliminary work Tergitol-7 was selected and the following series of tests carried out. The contaminated starch was used in making up starch tryptone agar.

Test 1. Tergitol-7 was added to starch tryptone agar to make final concentrations of 0, 1:60,000, 1:40,000, 1:30,000, and 1:20,000. This was tubed in ¾ in. × 6 in. tubes to a depth of 3½ in. and the tubes sterilized in the Arnold for exactly 30 minutes. At the end of eight days the tubes with 0 concentrations showed abundant surface growth and some growth throughout the entire column of agar. None of the tubes with 1:30,000 or 1:20,000 concentrations showed growth. All the tubes with 1:60,000 showed growth, and five out of six of the 1:40,000 tubes showed limited growth. The sterile tubes containing 1:30,000 and 1:20,000 were melted and poured into Petri dishes. These were streaked with five species of Streptomyces. Normal growth was obtained on all 1:30,000 plates and on all but one of the 1:20,000 plates.

Test 2. A soil suspension to give a final concentration of 1:10,000 was added to five deep tubes of starch tryptone agar and to five tubes of the same containing 1:20,000 Tergitol-7. The tubes were then sterilized for 30 minutes in the Arnold. At the end of eight days all control tubes showed abundant surface growth and some growth at all levels. None of the tubes containing Tergitol-7 showed growth. The sterile tubes containing 1:20,000 Tergitol-7 were poured into Petri dishes and streaked with *Staphylococcus aureus, Penicillium notatum, Penicillium* spp., *Aspergillus niger,* and *A. flavipes.* All these organisms showed characteristic growth.

TABLE 1

Tergitol-7 Concentrations

	0	1:40,000	1:20,000	1:10,000
E. coli	xxx	xxx	xxx	xxx
Staph. aureus	xxx	xxx	xxx	0
B. subtilis	xxx	xxx	xx	0
B. mycoides	xxx	xxx	0	0
B. sp. (heat res.) ..	xxx	xxx	0	0

Test 3. Tergitol-7 was added to tubes of nutrient broth in concentrations of 0, 1:40,000, 1:20,000, and 1:10,000. These were sterilized in the autoclave at 15 pounds for 20 minutes. They were then infected

with *Escherichia coli, Staph. aureus, Bacillus subtilis, B. mycoides,* and the heat-resistant bacillus mentioned above. Results were as shown in Table 1.

A loopful of broth from the tubes showing no growth was then streaked on nutrient agar slants. No growth was observed on any of them. This test was repeated three times with the same result.

Test 4. Since running the above tests a large number of starch tryptone agar tubes containing 1: 30,000 Tergitol-7 have been sterilized in the Arnold for 30 minutes and allowed to stand at room temperature for at least eight days before using. About 4 per cent of these have shown limited growth.

SUMMARY

Starch tryptone agar containing 1: 20,000 Tergitol-7 was successfully sterilized in the Arnold by one 30-minute heating period. Decreasing the concentration to 1: 30,000 resulted in 4 per cent failures.

A concentration of 1: 20,000 in the cold killed spores of *B. mycoides* and an unidentified heat-resistant bacillus but failed to kill spores of *B. subtilis.*

Concentrations of 1: 30,000 permitted growth after sterilization of all species of Streptomyces which were tested, while concentrations of 1: 20,000 permitted growth of all species but one.

Concentrations of 1: 20,000 did not inhibit the growth of selected species of *Penicillium* and *Aspergillus* or of *Staph. aureus.*

Concentrations as high as 1: 10,000 did not inhibit the growth of *E. coli.*

Reference

1. BAKER, Z., HARRISON, R. W., and MILLER, B. F. *J. exp. Med.*, 1941, 73, 249 271.

A Method for Continuous Parenteral Administration of Penicillin and Other Drugs

BAXTER G. NOBLE, 1ST LT., MC
The Good Samaritan Hospital, Lebanon, Pennsylvania

The rapid systemic elimination of penicillin necessitates frequent and often uncomfortable injections. The method here used eliminates this disadvantage by the use of an inlying, deep subcutaneous needle connected to a syringe with automatic feed.

As shown in Fig. 1, the apparatus consists of two flashlight batteries (in series) connected, through a potentiometer, with two steel (needle) electrodes immersed in an electrolyte (3 per cent KOH). An outlet from the electrolyte bottle connects, through a rubber tube and stopper, with a rubber finger cot inside the syringe. As gas is formed, the finger cot expands, forcing out the contents of the syringe. Adjustment of the potentiometer affords control over the rate of injection. In the model employed, injection rate could be varied from 1 cc. per minute to 1 cc. per hour. To use, penicillin (100,000 units) is dissolved in 20 cc. of normal saline, loaded into the syringe, and the potentiometer adjusted to the desired rate of flow as shown by the improvised Murphy drip (usually 1 or 2 cc. per hour). The original model is compact and in its entirety can be strapped directly to the leg or to an arm board, allowing relative freedom of movement; however, for more uniform injection elevation of the syringe at least two feet above the level of the patient is preferable. Battery drain is negligible, a single set of dry cells giving over 100 hours of service. The potentiometer should, however, be advanced to the full "on" position every six hours to depolarize the electrodes and prevent slowing up of electrolysis.

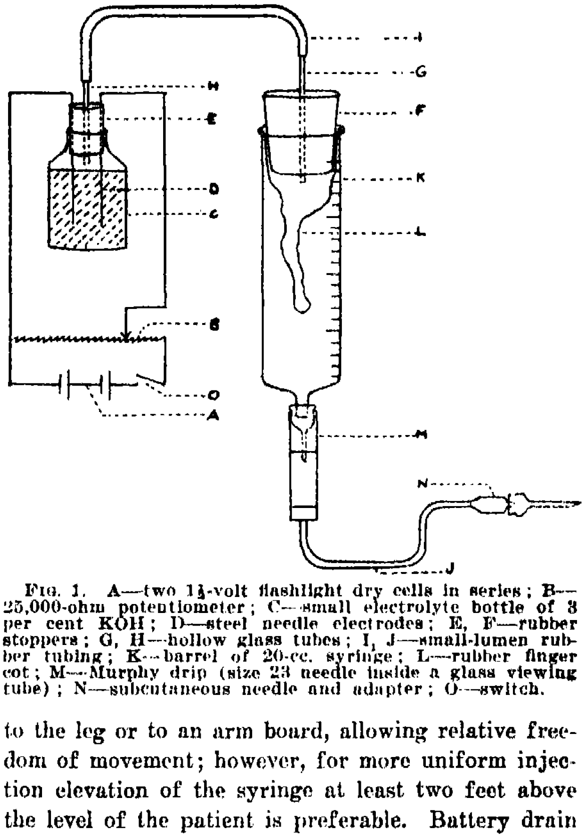


FIG. 1. A—two 1½-volt flashlight dry cells in series; B—25,000-ohm potentiometer; C—small electrolyte bottle of 3 per cent KOH; D—steel needle electrodes; E, F—rubber stoppers; G, H—hollow glass tubes; I, J—small-lumen rubber tubing; K—barrel of 20-cc. syringe; L—rubber finger cot; M—Murphy drip (size 23 needle inside a glass viewing tube); N—subcutaneous needle and adapter; O—switch.

Continuous injection over 10- to 12-hour periods occasioned very little discomfort, though there was moderate residual tenderness that soon subsided. Only one reaction was observed, consisting of pronounced local irritation following removal of the needle and apparently caused by too rapid injection. The rate of injection should be slow enough for absorption to occur almost immediately, with minimum subcutaneous collection of fluid. The apparatus is also applicable for constant intravenous injection of penicillin and other drugs.

Letters to the Editor

Atomic Bombs and Novae

A number of people—and they are not all nonscientists—are apparently somewhat disturbed over the prospect of an atomic bomb explosion detonating the whole earth and producing a nova. When those not versed in physics have raised the question with me, I have usually explained the packing effect, stability of nuclei, and have pointed out that, while the fission of uranium releases energy, the splitting of the two most abundant elements of the earth's crust, oxygen and silicon, would absorb energy. This usually satisfies or bewilders the inquirer.

But a few physicists have put the question this way: "Granted that all our experiments and theories are correct *so far as they go, and on the laboratory scale*, do they go far enough, and can we be confident that they apply on the scale of the proposed test, in which an atomic bomb is to be exploded in contact with the surface of the ocean?" The question is naturally followed by another: "Do we know that the novae we observe out in space are not actually planets whose physicists have carried nuclear research just a little too far?" Not being a nuclear physicist, I can't answer the first question; as a student of the novae, I believe I can give a partial answer to the second.

The novae are definitely *stars*—that is, self-luminous bodies of gas with dimensions that greatly exceed those of the earth. More than a score of novae were recorded on photographs before their great explosive outbursts. After the explosions were over, the stars quieted down and assumed again (in every case for which the record is adequate) a brightness that agreed with the prenova magnitude very closely, if not exactly. Four examples of recurrent outbursts at intervals of a number of years are known. One of these stars at minimum was too faint to appear on the older photographs, but the other three show no appreciable change from one intereruption stage to the next. The explosion is evidently relatively superficial and produces no appreciable permanent alteration of the star.

Except for the recurrent novae and one other (Nova Aquilae 1918), more intimate observations of the prenova stars are not available, but the postnova stars have been well observed in about a score of cases. They are all of a perfectly distinct and unmistakable type, quite unlike "normal" stars (such as the sun). Their total brightness is similar to that of the sun, on the average, but they are much smaller than it and have much higher temperatures. Their densities must be from 100 to 1,000 times that of water; they are "subdwarfs," intermediate between "normal" stars and the very dense and small "white dwarfs."

Observations of the spectrum of a nova in the quieting-down stages of the eruption indicate pretty clearly that the outburst originated in the star and not in a satellite of it. The scale of the explosion is vast; the luminosity exceeds that of the star at its normal minimum for at least a few years, and the amount of matter erupted is in the neighborhood of 100 times the mass of the earth. Thus, a giant planet would be required, though it should be possible to observe a similar explosion of an earth-like mass if one occurred. The fact that several novae have continued to vary for many years, and that a few were variable before the outburst, is similarly definite evidence of the stellar nature of the explosion. It would be quite remarkable if every one of the too-inquisitive planets were associated with the same very peculiar type of star. And the fact of recurrence is similarly irreconcilable with the suggestion of a planetary accident.

Thus, the well-observed novae are quite conclusively in disagreement with the planetary explosion hypothesis, and no other observation supports it. But of course there are a number of novae for which the observational record is so sketchy that we can only say they do not contradict the preceding statements. If the suggested catastrophe were to be admitted as a physical possibility, then I could not deny that among the *most imperfectly observed* novae some might have been produced in that way.

The above statements are not made in defense of the atomic bomb tests, but simply in answer to a question that has been raised privately enough times to make a public answer appear in order.

DEAN B. MCLAUGHLIN
Observatory of the University of Michigan

Facts, Feelings, and Freedom of Science

In his reply (*Science*, 1946, **103**, 404) to our letter, "Freedom of science in the Soviet Union" (*Science*, 1946, **103**, 281), Sergei Gaposchkin, of the Harvard College Observatory, accuses that our letter "does not contain facts but only feelings."

We presented at least three facts: (1) the nonexistence of freedom of science in the Soviet Union, (2) the imprisonment and death in a concentration camp of N. I. Vavilov, and (3) the imprisonment of many other scientists in the Soviet concentration camps. We are also sure that Dr. Gaposchkin, as an astronomer, knows about the purge of Soviet astronomers in which some prominent scientists were liquidated (see R. Simpson. *Sat. Rev. Lit.*, 30 March, p. 30). But he ignores all these facts, calling them feelings, and then indulges in an emotional outburst.

What bearing on the freedom of science has, for instance, the very regrettable fact of huge Soviet losses in the last war? The Soviet Government used to imprison and execute scientists many years before the war and continues to do so. The statement that the lives of 130,000,000 Americans were saved by the Russians not only has not even the slightest connection with the subject raised by us but is very controversial, because many Americans think that the United States saved the Soviet Union. We believe the proper place to discuss all these questions injected into controversy by our opponent is

Russian newspapers and magazines and not an American scientific periodical.

As to the contention that our letter does not contribute to the friendship of the United States and the Soviet Union, we are strongly convinced that the friendship between two great nations cannot be built on the basis of misrepresentations and appeasement of tyrants. Munich showed us the futility of such a cowardly policy. The thesis that everybody who is criticizing the Soviet Government or even its certain policies is an enemy of the Russian people is well established in the USSR but not necessarily in the United States, where public opinion seems to understand that the Government and the people of the Soviet Union are not synonymous, as is the case in all totalitarian countries. It means also that the Russian people should not be held responsible for the crimes of its Government. The purpose of our letters is to stimulate public opinion against the slavery of science in the Soviet Union, because we think that the freedom of science is a prerequisite for the establishment of normal international cooperation in that field and is also a safeguard against the use of science for aggressive war purposes. We know that we cannot please everybody: the oppressors and the oppressed, the proponents and opponents of the Soviet regime. Our choice is the side of Russian people and not of its oppressors.

In conclusion, we venture to mention that even the indiscriminate use of quotation marks cannot change the fact that we never said that we do not understand the language of common Russian people. One has only to read the last sentences of our letter to see that we referred simply to the constant and persistent misuse by Soviet propagandists of such words as freedom, democracy, etc. That such practice of many years in a totalitarian country, isolated by the iron curtain from the outside world, can affect the minds of the people, especially of the younger generation, was abundantly demonstrated by Hitler and hardly can be denied. And that is why we mentioned that probably we and Dr. Zhebrak talk different languages.

VLADIMIR C. ASMOUS

Arnold Arboretum, Harvard University

On Science and Government Subsidies

The discussion in *Science* of the proposed government support of scientific research reveals that while some scientists do not seem to realize the tragic deterioration in the character of the U. S. Government, there are many practical scientists who fully comprehend the facts in the case. Thus, the letter from M. W. Welch (*Science*, 1946, 103, 430) justly doubts the wisdom of enacting questionable legislation without surrounding it with adequate safeguards. Mr. Cohn, in the same issue (p. 430), outlines a plan for the sound administration of such an act.

However, many of us who have had actual experience in wartime government service both overseas and in Washington have become hard-boiled cynics where altruistic planning and control by the Federal Government is contemplated. Not only have we seen too much of incompetence, waste, and bureaucratic bungling, but also we have learned to question the real motives of most of the legislation publicized as being for "the public welfare." The Murray-Dingell-Wagner socialized medicine bill, the Kilgore-Magnuson bill, the national school lunch legislation, schemes for price control, anti-inflation, Federal housing, farm subsidies, atomic energy control, and what-have-you, all have as a common denominator an ulterior purpose—increasing regimentation of the American people, greater spending (and electing), and more jobs for bureaucrats. (Thus, the "public health" act would require the employment of 300,000 more jobholders.)

To place American scientific research in a bureaucratic straightjacket would greatly retard our own progress while other nations forged ahead. When and if the United States returns to its normal American form of government, crushing taxes are reduced, and restrictions and controls are removed from industry and agriculture, there will be ample surplus funds available from the incomes of generous American citizens and corporations to support sound scientific research foundations serving national needs with that independent efficiency found only among free men.

American science, which has contributed largely to making our United States the leader of the world, can continue its vital services to mankind without any additional government subsidies or supervision.

STANLEY F. MORSE

Winter Park, Florida

New Units for the Measurement of Radioactivity

In *Science*, 1946, 103, 712, E. U. Condon and L. F. Curtiss, representing the National Bureau of Standards and at the suggestion of the Committee on Radioactivity of the National Research Council, propose a new unit to replace the curie to express the strength of radioactive sources. They choose as the new unit 1,000,000 disintegrations per second, to which they assign the name "rutherford." A microrutherford would, therefore, be one disintegration per second.

While it is true that the curie was originally adopted in 1910 by the Congress of Radiology as a standard of radon, its use was later extended to any other member of the radium series in radioactive equilibrium with one gram of radium element. Subsequently the curie has been adopted as the unit of rate of disintegration of all radioactive elements. The accepted value is 3.7×10^{10} per second. While there has been some disagreement over this value, this is in no way the fault of the unit but lies rather in the inaccuracy of its physical measurement. A gram of radium in the form of a salt can be purified and weighed with an accuracy far exceeding that of any existing method of radioactive measurement.

The adoption of a new unit will not improve the methods of measurement or enhance the accuracy of the data. Hence, if it does not give added convenience, it seems to have no advantage and will simply lead to unfortunate confusion. The fact that the magnitude of the unit is unhappily chosen may be seen by consulting the values given in terms of curies, millicuries, and micro-curies for new fission products in Tables 1 to 6 in the same number of *Science* (pp. 700–704). In all cases the use of the new unit would give more awkward numerical expressions. The claim that the new unit is chosen so small as to avoid confusion with the curie is not an appealing one.

Finally, let me disclaim any disinclination to honor Lord Rutherford. No one could be more worthy of the highest honor in the field which he did most to create. But to name a new unit for him where one already exists seems to be superfluous and would spoil the term for future use. If there is to be a unit named for Rutherford, let it be one worthy of him.

The same authors further recommend a new unit, r.h.m. ("rum")—one roentgen per hour at one meter from the source for intensity of gamma radiation. The convenience of such a unit is something for radiologists to decide. Both questions should be referred to the appropriate international body of which the National Research Council is a member.

S. C. LIND, *Dean*
Institute of Technology, University of Minnesota

Thyroid Adenomas in Rats Receiving Selenium

We have observed increased size, hyperplasia, and loss of colloid in the thyroid glands of 16 white rats which had received 0.05 to 0.1 per cent bis-4-acetamino-phenyl-selenium dihydroxide in their diet for 10 days. Eight white rats which had received 0.05 per cent of the selenium compound for 105 days had multiple adenomas of the thyroid glands and adenomatous hyperplasia of the liver. A detailed description of the experiments, complete pathological findings, and comparative effects of other organic and inorganic selenium compounds will appear elsewhere. Here it suffices to point out the goitrogenic action of the selenium analogue of a sulfur compound and its property of producing adenomatous changes in a relatively short time.

JOSEPH SEIFTER, W. E. EHRICH,
GEORGE HUDYMA, and GEORGE MUELLER
Wyeth Institute of Applied Biochemistry
Philadelphia

Cestode "Parasitized" by Acanthocephalan

While engaged in a survey of the fisheries of Great Bear Lake, Northwest Territory, for the Fisheries Research Board of Canada, the writer observed that nearly all the lake trout, *Cristivomer namaycush* (Walbaum), were hosts to two intestinal parasites. One of these was the cestode, *Eubothrium salvelini* (Schrank), and the other the acanthocephalan, *Echinorynchus salvelini* (Linkins). Normally, both parasites were attached to the intestinal mucosa of the host, the tapeworms by their scolices and the acanthocephalans by their proboscides. A number of specimens of each were preserved for record and study. This winter an examination of the preserved tapeworms revealed that those from two different trout had some of the acanthocephalans firmly attached to their bodies. One cestode had four of them. Each acanth cephalan had buried its proboscis to the full extent in th strobila of the tapeworm. Some were attached to th sides of the cestodes and others to the ventral and dorsa surfaces. The specimens attached to the tapeworms appear similar in every respect to those which were attache to the host's gut.

Since the proboscis of the Acanthocephala is, like th scolex of a tapeworm, solely an organ of attachment a not a means of gaining nourishment, this relationship not truly parasitism. Although attached to the ta worm, the acanthocephalan is still parasitic on the tro as it is from the trout that the food supply is derived.

This association of parasite and parasite probably aro when some of the acanthocephalans, arriving in the inte tine of a trout, found the attachment sites preoccupi by a large number of the tapeworms. In seeking to fi themselves, they imbedded their proboscides in the onl available solid objects—the tapeworms.

R. B. MILLE
University of Alberta, Edmonton

Antipurpuric Action of A-Tocopherol (Vitamin E)

Stilbestrol given intramuscularly and intravenously to four dogs in doses of 10–20 mg./day quickly produced increased capillary fragility, prolonged bleeding and clotting times, and reduced platelet counts. When this dosage was continued for 14–25 days, a true purpura developed. This could end in widespread, large and small subcutaneous and visceral hemorrhages, bleeding into the body cavities, or even hemorrhagic death. These observations had been made previously by Castrodale, *et al.* (1941), and by Tyslowitz and Dingemanse (1941).

Giving these purpuric dogs testosterone propionate seemed not to be helpful; but administering synthetic α-tocopherol acetate (ephynal-Hoffman-La Roche) in oral doses of 200 mg./day quickly cured the purpuric animals, restoring platelet counts and capillary fragility to normal. If given sooner, it prevented the appearance of the frank purpuras and the blood-vascular deficiencies.

The antipurpurogenic action of vitamin E has been demonstrated to be valid for human purpuras also. Five thrombocytopenic purpura patients, one of whom had not been helped by splenectomy, had platelet counts and capillary fragility quickly restored to normal or near normal on 200–400 mg. ephynal orally per day; their clinical evidences of purpura disappeared proportionately. There was a great clinical improvement in one man having terminal purpura and aplastic anemia associated with advanced lymphosarcoma, as well as in three women who bruised readily, suffered from menorrhagia and metrorrhagia, and showed slightly reduced platelet counts.

This effect of vitamin E at the above dosage appeared in 7–14 days, but it seems that the treatment must be continued for long periods of time, if not permanently.

FLOYD SKELTON, EVAN SHUTE,
H. G. SKINNER, and R. A. WAUD
University of Western Ontario, London, Canada

Book Reviews

Fluorochemistry: a comprehensive study embracing the theory and applications of luminescence and radiation in physicochemical science. **Jack De Ment. Brooklyn, N. Y.: Chemical Publishing Co., 1945. Pp. xvii + 796. (Illustrated.) $14.50.**

This book is devoted to a discussion of fluorescence and phosphorescence from both the theoretical and experimental points of view. The author's literary style is such that one receives the impression that he writes with little effort. Ordinarily this characteristic would make a book a great relief from the more ponderous efforts of some other writers, but in this case the author either has not read or has not understood the literature basic to the field, and therefore much of the book is worthless. The compilations of statements concerning fluorescence and phosphorescence such as are found in Chapters III, IV, VII, VIII, and IX may be found useful but are admittedly not complete. For example, the list of fluorescent organic substances given in Chapter III is stated to be one-tenth of a list published elsewhere.

The reviewer wishes to point out some examples of the errors made in the theoretical discussion. On pages 31 and 53 the author uses the term ''quantization'' as equivalent to excitation. That he really intends such usage is shown by his definition of the term on page 738. Apparently he does not realize that unexcited atoms and molecules are in definite quantized states. His unfamiliarity with the quantum theory is apparent also in his discussion of spectra. On page 58 he speaks of a $1S_{\frac{1}{2}}$ term; on pages 61 and 62 he has a weird jumble of comment about the Raman effect and atomic spectra; on pages 55 to 58 he discusses atomic spectra but seems to be unfamiliar with the standard notation. On pages 64 and 65 he attempts to discuss the Franck-Condon principle and ends up with a statement in which that principle and the effect referred to as predissociation are confused. Another confusion of ideas appears on page 91, where he undertakes to discuss the ''thermodynamics of fluorescence'' without distinguishing between a true equilibrium and a photostationary state.

Another objectionable feature of the book is the author's attempt to attach his name to principles which did not originate with him. For example, on page 2 he speaks of De Ment's first law of fluorescence, claiming that he stated it in 1942 as: ''Before emission can occur from a luminescent system, absorption must first take place.'' The reviewer does not know when that statement first appeared, but he found the following in the *Encyclopedia Britannica* (11th ed., Vol. 10, p. 577): ''Fluorescence is always associated with absorption, but many bodies are absorbent without showing fluorescence.'' His other principles and laws have the same degree of originality.

The binding of the book is poor, but it will probably last as long as is necessary. Other books costing less money are more valuable.

G. K. Rollefson

University of California, Berkeley

The Hormones IN HUMAN REPRODUCTION

"This is popular science at its best!"
—SCIENTIFIC BOOK CLUB REVIEW

By GEORGE W. CORNER

SCIENCE: ''A masterpiece . . . a detective story involving the innumerable facts accumulated during the past century by many inquisitive scientists . . . Laymen, physicists, chemists, biochemists, and biologists alike will find this skillful narrative exceptionally interesting and valuable.''

ENDOCRINOLOGY: ''A skillful refutation of the current concept that scientific writing, to be accurate, must also be dull . . . Will be read by the biologist as an absorbing document of contemporary science.''

JOURNAL OF THE AMERICAN MEDICAL ASSN.: ''One of the most delightful books that has come to the attention of the reviewer in many years.''

Contents

The place of the higher animals, and of mankind in particular, in the general scheme of animal reproduction. The human egg and the organs that make and care for it. The ovary as timepiece. The hormone of preparation and maturity. A hormone for gestation. The menstrual cycle. Endocrine arithmetic. The hormones in pregnancy. The male hormone. Chemical structure of the sex gland hormones.

A SCIENTIFIC BOOK CLUB SELECTION

266 pages, 56 illustrations.
Third printing, $2.75

At your bookstore

PRINCETON University Press

Faune de France 44: Coléoptères bruchides et anthribides. **Adolphe Hoffmann. Paris: Paul Lechevalier, 1945. Pp. 184. (Illustrated.) 250 fr.**

This is a comprehensive manual dealing with the species of Bruchidae, Urodonidae, Anthribidae, Brentidae, and Nemonychidae which occur in France. The systematic treatment of the species of each family is preceded by a discussion of larval and adult anatomy and of the relationships and biology of the family as a whole. With the object of facilitating identification, easily seen characters, many of which are illustrated by line drawings, are employed in the keys; in addition, the adults of most species are figured. Bourgin's illustrations of the Anthribidae are especially praiseworthy. A bibliography of 46 titles, a combined generic and specific index, and an alphabetical list of food plants complete the paper.

Taxonomic changes of interest are the removal of *Urodon* from the Anthribidae to form a separate family, Urodonidae, and the transfer of Anthribidae from Rhynchophora to Phytophaga. The family Nemonychidae is considered transitional between the Curculionidae and Scolytidae, which is at variance with Van Emden's conclusions, based chiefly on larval studies, that this group belongs in, or next to, the Anthribidae.

Dr. Hoffmann retains *Bruchus* on the grounds of common usage, though recognizing that the name is unavailable under the rules of nomenclature; and this course will probably meet the approval of most entomologists. Certain other usages, however, are questionable. For example, the two distinct species, *Acanthoscelides obtectus* Say and *A. obsoletus* Say, are synonymized; the adoption (p. 124) of ''itae,'' instead of the standard ''inae'' as the termination for subfamily names seems an ill-advised innovation; Araeocerus (staphylinid) should be *Araecerus* and Brenthidae, Brentidae; ''*Bruchus villosus* F.'' (footnote, p. 83) is said to belong to *Spermophagus*, but it is not mentioned under that genus, although *villosus* was originally described from Germany and (if the locality is correct) should occur in France.

These and a few other minor obscurities and errors scarcely lessen the practical usefulness of Dr. Hoffmann's paper.

L. L. BUCHANAN

Bureau of Entomology and Plant Quarantine
U. S. Department of Agriculture, Washington, D. C.

Science and scientists in the Netherlands Indies. **Pieter Honig and Frans Verdoorn. (Eds.) New York: Board for the Netherlands Indies; G. E. Stechert, 1945. Pp. xxiv + 491. (Illustrated.) $4.00.**

The late conflict has made the world conscious of the Netherlands Indies as never before. The appearance at this time of a solid book on their science and scientists is most timely. At the same time, one is inclined to suspect propaganda in favor of the Netherlands rule. The reader, however, will find here only a remarkably broad and wholly unbiased picture of the development and status of pure and applied natural science in the area. It is, as it were, a review of the past up to the Japanese invasion, aimed to gain a vision for the future and, perhaps, to draw ''some who feel that they have training and knowledge which can be used there for the good of mankind.''

The book consists of over 75 original and reprinted articles, mostly in English, with a few in French or German. Some are translations from the Dutch of valuable papers not previously available to most readers. The range of subjects covered in these closely printed pages is surprising. These include: livestock and the veterinary service, mineral resources, climate, volcanology and seismology, rubber, cinchona, medicine, archaeology, anthropology, fish and fisheries, agriculture, chemistry, forestry, astronomy, zoogeography, phytogeography, soils, extraction of naval stores, paper pulp, sedimentation, botany, paleobotany, geology, hydrodynamics, and exploration. The last subject is enlarged by delightful selections from the travel books of H. O. Forbes, David Fairchild, and F. Schneider, the last in German. Among the scientists dealt with biographically are Felix Meinesz, the exponent of international cooperation through geoscience; Junghuhn, linked with cinchona culture; and Rumphius, the blind seer of Amboina. Historical accounts, some of which are in French, deal with various developments and the institutions fostering them. The dependence of the growth of natural science on political social, and racial development is recognized in the inclusion of a reprinted article by Jan Brock which analyzes the diversity and unity in southeastern Asia and their implications for future political developments. Some of these articles deal as much with other areas as with the Netherlands Indies, and some include clear general explanations of the subject essential for the layman's background. Thus, an article on the geodesist, Meinesz, explains the differences in earth densities before discussing its measurement in the suboceanic lithosphere and its relation to mountain building and volcanism. Many of the articles are well documented with bibliographies, and a list of bibliographies on the area appears near the end. These, along with a list of prewar scientific institutions, broadly interpreted, and an address list of their staffs, renders this an invaluable reference work.

Anthologies of poetry and prose are well recognized means to enlighten busy people with the best in these fields. Here is an anthology of regional science which is worthy of many successors. It is unfortunate that the dictates of economy compel the adoption of such a compact format and the use of such small type for many parts. A more systematic arrangement of articles would have enabled the busy specialist to find more easily the material in his field, but perhaps the mixing of subjects was deliberately intended to compel the reader to at least rub elbows with adjacent fields, if not to shake hands and browse. In fact, one must be a browser in this book, for there is no index, its place being taken by a very full table of contents.

EGBERT H. WALKER

Smithsonian Institution, Washington, D. C.

Quality—Based on Standards and Craftsmanship

A Skin 4/1,000,000" Thick

Surfacing a lens with Balcote* requires a coating that is optically one-quarter of one wavelength of light thick . . . only four millionths of an inch!

Special equipment, in a matter of minutes, deposits a skin on the glass with exact control of thickness, producing the Balcoted surface. The accomplishment of this operation on a production basis represents the evolution of methods and materials on which Bausch & Lomb scientists have worked for many years. Bausch & Lomb Optical Co., 642-6 St. Paul Street, Rochester 2, New York.

*Balcote Transmission Film is the revolutionary Bausch & Lomb lens surface treatment which reduces reflection and flare, and permits the passage of more light.

BAUSCH & LOMB

ESTABLISHED 1853

Scientific Book Register

Ault, James P., *et al.* *Oceanography—IV: The work of the "Carnegie" and suggestions for future scientific cruises.* (Publ. 571.) Washington, D. C.: Carnegie Institution of Washington, 1946. Pp. viii + 111. (Illustrated.) $1.50, paper; $2.00, cloth.

Bacharach, A. L. *Science and nutrition.* (2nd ed.) London: Watts, 1945. Pp. xii + 142. 5s.

Bancroft, Frederic W. (Ed.) *Surgical treatment of the nervous system.* Philadelphia: Lippincott, 1946. Pp. 534. (Illustrated.) $18.00.

Barber, Marshall A. *A malariologist in many lands.* Lawrence, Kans.: Univ. Kansas Press, 1946. Pp. 158. $2.50.

Coleman, Satis Norrona Barton. *Volcanoes new and old.* New York: John Day, 1946. Pp. 229. (Illustrated.) $3.75.

Glasstone, Samuel. *The elements of physical chemistry.* New York: D. Van Nostrand. Pp. 702. (Illustrated.) $4.50.

Graham, Evarts A. *1945 year book of general surgery.* (Practical Med. Ser.) Chicago: Year Book Publishers, 1946. Pp. 736. (Illustrated.) $3.00.

Huxley, Aldous Leonard. *Science, liberty and peace.* New York: Harper. Pp. 86. $1.00.

Korff, Serge A. *Electron and nuclear counters—theory and use.* New York: D. Van Nostrand. Pp. vii + 212. $3.00.

Lantis, Margaret. *The social culture of the Nunivak Eskimo.* (Transactions, Vol. 35, Pt. III.) Philadelphia: American Philosophical Society, 1946. Pp. 153–323. (Illustrated.) $2.50.

Light, Richard Upjohn. *The progress of medical geography: a proposed atlas of diseases.* (Reprinted from *Geogr. Rev.*, 1944, 34, 636–654.) New York: American Geographical Society.

Munn, Norman L. *Psychology.* Boston: Houghton Mifflin, 1946. Pp. xviii + 497. (Illustrated.) $3.25.

Nordstrom, Frithiof, and Wahlgren, Einar. *Svenska fjarilar systematisk bearbetning av sveriges storfjarilar Macrolepidoptera.* Stockholm: A. Sohlman, 1941. Pp. 353. (Illustrated.)

Pidduck, F. B. *Currents in aerials and high-frequency networks.* Oxford: Clarendon Press, 1946. Pp. 97. $2.50.

Sherman, Henry C. *Chemistry of food and nutrition.* (7th ed.) New York: Macmillan, 1946. Pp. 675. (Illustrated.) $3.75.

Smith, Carroll N., *et al.* *Biology and control of the American dog tick.* (U. S. Dept. of Agric., Tech. Bull. No. 905.) Washington, D. C.: Government Printing Office, 1946. Pp. 74. (Illustrated.) $.20.

Smith, Hobart Muir. *Handbook of lizards; lizards of the United States and of Canada.* (Handbooks of American Natural History, Vol. 6.) Ithaca, N. Y.: Comstock Publishing Co. Pp. 578. (Illustrated.) $5.75.

Wiener, Peter F. *German for the scientist.* Brooklyn, N. Y.: Chemical Publishing Co., 1946. Pp. xii + 238. $3.50.

Catalogue Corner

Please write directly to the company indicated for any publication you wish mentioning the bulletin number and *Science*. Publications are gratis unless otherwise noted.

Immersion pyrometer. This immersion pyrometer has been designed for the nonferrous industry and embodies numerous improvements for ruggedness, dependability accuracy, and ease of operation. This design includes a large 4½-inch indicator with a 4-inch direct reading scale calibrated from 0–1,500° F. or 0–2,500° F. or equivalent Centigrade. Two models with over-all lengths of 27 and 43 inches are manufactured, both having an especially designed swivel 3 inches from the connector block which permits the use of the pyrometer at any angle. The swivel is equipped with toothed notches preventing it from becoming loose during operation. The instrument can be used with "bare metal" and "protected"-type thermocouples, both being instantly interchangeable. The thermoelectric system, constructed with a permanent magnet, low-resistance-type galvanometer, has an internal automatic cold end compensator in addition to an external adjusting screw and is enclosed in a shock-, moisture-, and dust-proof steel case. *Catalogue 150 SC–51* illustrates and describes this instrument in detail. The Pyrometer Instrument Company, 10 Lafayette Street, New York 13, N. Y.

Thermocouple-Ionization Gauge Control. The Thermocouple-Ionization Gauge Control is a unit which incorporates circuits for use with NRC Type E Thermocouple Gauge or any standard ionization gauge, complete with power supply. Using National Research Corporation Type 507 Ionization Gauge, which is standard equipment with the Control, the range of vacuum measurement from 1 mm. to 2×10^{-9} mm. of mercury is covered. The Thermocouple Gauge handles pressures from 1 mm. to 10- mm., and the Ionization Gauge works from 5×10^{-8} mm. to 2×10^{-7} mm. of mercury. The sensitivity of the Ionization Gauge may be doubled by doubling the grid current. Readings of the Ionization Gauge range are spread by a multiplying switch to indicate full-scale meter deflection for 5, 1, 0.1, or 0.01 μ when used with Type 50 Ionization Gauge. Features include a production-test Thermocouple Gauge circuit and an Ionization Gauge circuit with outgassing provision, interlocking relay for protection, zero set, and zero adjust controls for amplifier balancing. Write for *Information Sheet SC–* National Research Corporation, Boston 15, Mass.

Indian Agricultural Research Institute
LIBRARY
NEW DELHI-12

This book can be issued on or after

Return Date	Return Date	Return Date	Return Date

Unless a borrower points out the injury at the time of borrowing the book, he shall be required to replace the book or pay its price, if detected at the time of return.

HELP US TO KEEP THIS BOOK FRESH AND CLEAN